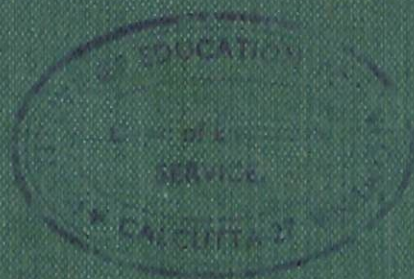


1941

# WOODEN TOY MAKING





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**WOODEN  
TOY=MAKING**

BY

WINIFRED M. HORTON

With Illustrations

by

M. McLEISH AND  
THE AUTHOR



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## PREFACE

THIS little book on toy-making has been put together for the especial use of teachers. None of the toys illustrated herein is shown as a model faithfully to be copied. We do not 'hold with' copying: copied form is apt to degenerate. We say to the teacher, 'Use your own designs', and we *suggest* only—by the illustrations and instructions—how the teacher who has had no serious training in Art and Craft may set about it. Diagrams for tracings (full size) are given only where necessary for fitting or jointing.

After considerable experience in conducting Art and Craft courses for teachers, we find that the whole *object* in this work is not clearly understood; that school teachers of craft work almost invariably aim at producing an *efficient article*—hence the desire for ready-made diagrams and models, easy to read and reproduce.

This is an entirely wrong attitude for education to adopt. Efficiency, workman-like perfection—attributes desirable enough in themselves—are *not* the goal of educational effort. They belong, quite rightly, to the world of commerce. The aim of education is to teach people how to *learn* throughout life and to bring out and develop in themselves those qualities which pertain both to racial inheritance and individual ability.

With this true educational aim in view, we should begin our efforts in the field of Arts and Crafts. We take up, let us say, toy-making, and we experiment with our own notions on the lines indicated. Teachers must work as the child works, striving after an idea of their own. Otherwise they will never understand the workings of the creative side of the child's mind. They cannot, of course, help knowing more about the *processes* of the craft in practice, but they must make these processes serve the idea—not ruthlessly destroy the idea for the sake of a bit of mechanical perfection. Commerce can, and does, do that for us in the articles it gives us for our daily use. It may be implicit in manufacture—but education is not a reproducing machine. Good workmanship (or, at least, adequate handling) will follow as the night the day—where enthusiasm has been kindled and vision developed.

Workmanship alone will not suffice. *Works without faith are dead* (if the misquotation is pardonable!).



In turning over the leaves of this little book, you will see that we have planned our toy-making experiments with certain definite ideas about the artistic possibilities latent in the simplest of means-to-end.

The built-up toys, for example, are exceedingly simple to achieve. The mere fact of building-up in the round—as opposed to the tame method of cutting out in the flat—has serious æsthetic satisfaction. It is possible to ‘walk all around’ the image—to observe the way the light falls on one side and shadow on the other—to ‘feel’ literally with one’s own hand its actual form. We have found that few people realize the actuality of form: they are accustomed to make their marks on paper and have no idea of what form in three dimensions really means.

A simple wooden toy, built up as described, would reveal it.

What children do instinctively the teachers must learn consciously—because they have passed the age of instinctive learning—but they *should do the same things together*—either ‘behind the scenes’, as it were, or even in Class. Let teacher and pupil learn together.

In working out these toys, the value of using different thicknesses of wood to obtain variety will be seen; and a sharp look-out must be kept for happy accidents. For example, the little dress of ‘Mary’. When cut, the pieces did not fit, but see how delightfully they give the *flowing* out of the skirt, caught in the breeze!

As to colour, let us be definitely imperative. *Keep it bright*. A toy is a gay thing—and can afford to be even fantastic in colour. Paint it *like* a toy—not all black and brown and dark red and green. Try out your higher-keyed colours—delicate yellows and pinks—greys and greens. Regard the *plain* wood itself as colour (it is), and use only a *little* other colour with it, sometimes. It is not necessary to plaster the wood all over with many colours, or with much pattern. A dainty stripe, a brilliant bit of simple play of dark dot on light, or light dot on dark, this suffices. It will teach children more about the proper application of colour and pattern to objects than many a long lesson on theoretic lines. M. McLEISH

## ACKNOWLEDGMENTS

The illustrations on pages 18–21, and on 50 and 51, are made from rough notes of students’ work—most of them first efforts. I am very grateful to those students who gave me permission thus to make use of their work—and especially to those whose permission I have not asked.

W. M. H.

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## EQUIPMENT AND MATERIALS

## TOOLS Etc.

Small saw. Fretsaw, with small cutting table and clamp.

Archimedean drill and assorted bits.

Chip carving knife (blade inset) or penknife.

Small oilstone and oil.

Small hammer.

Small round-nosed pliers.

Wire-cutters.

Half-round rasp file, medium, 6 in. long.

Scissors. 12-in. ruler. Small set-square, or try-square.

Pencil. Pair compasses. Vice, cramp or press.

Small bench block, 9 in. by 6 in. or 12 in. by 9 in. (This is most useful when the work has to be done on an ordinary table or desk.)

Panel (or veneer pins), very fine,  $\frac{1}{2}$  in.,  $\frac{3}{4}$  in. and 1 in. long.

Wire nails, fine, flathead,  $\frac{3}{8}$  in.,  $\frac{1}{2}$  in. and 1 in. long.

Cotter pins, 1 in. and  $1\frac{1}{4}$  in. long.

Screw-eyes,  $\frac{3}{4}$  in. long.

Staples, small size,  $\frac{3}{8}$  in. -  $\frac{1}{2}$  in. long. Wire, tinned, 15 and 20 gauge. Glue.

Glass-paper, Coarse M. 2 and Fine M.  $1\frac{1}{2}$ . Tracing paper.

String. Corks. Beads etc.

FOR TOYS ON PAGES 48-55, ADD TO THE ABOVE:

Small screwdriver and screws.

Brace and 4 bits,  $\frac{1}{8}$  in.,  $\frac{3}{16}$  in.,  $\frac{1}{4}$  in. and  $\frac{1}{2}$  in.

WOOD. White deal, ready planed. This may be ordered by 'Nominal' size, i.e. size before planing, which is about  $\frac{1}{8}$  in. larger than 'Actual' size, i.e. size after planing.

The wood used for these toys, unless otherwise stated, is  $\frac{1}{2}$  in. 'Nominal', i.e.  $\frac{3}{8}$  in. 'Actual'.

Plywood, odd pieces, about  $\frac{1}{8}$  in. or 3 mm. thick.

Strip wood.

Birch dowels,  $\frac{3}{16}$  in.,  $\frac{3}{8}$  in.,  $\frac{1}{2}$  in.,  $\frac{3}{4}$  in. and 1 in. diameter (or broomstick).

PAINTS etc. Particulars of these are given in the CRAFT NOTES.

## CRAFT NOTES

### DESIGNING

For making the toys in Chapter III, it is necessary to plan them first on paper and then trace these working drawings on the wood, ready for cutting with the fretsaw. If there is any doubtful part, try it out in thin cardboard or thick paper. This may save unnecessary cutting of wood.

### USE OF FRETSAW

See that the saw blade is taut; the teeth should point downwards.

Work with blade at right angles to wood, thus avoiding 'undercutting'.

Do not be heavy-handed: this tool responds to kindness!

### CUTTING

When placing the patterns for cutting out, on the wood, take great care to arrange them so that the grain runs, as nearly as possible, lengthwise of any part that sticks out from the general mass—such as the legs or tail of an animal. This arrangement will prevent breaking, as the strength of the wood runs with the grain, not across it.

After cutting, make all pieces smooth and neat with glass-paper.

Before nailing and gluing, arrange the pieces in their correct position. If any further shaping is necessary, it can generally be done with the rasp file, or if the alteration is very slight, glass-paper can be used.

Keep all waste pieces. They will 'come in' later on.

### NAILING AND JOINTING

Before nailing two pieces of wood together, always bore a hole (with the Archimedeian drill) in the upper piece. This (1) gives the right direction for the nail, which can then be hammered in with freedom, and (2) prevents the wood from splitting.

To make a nail specially firm, it is sometimes a good plan to 'clench' it, i.e. use a long nail and bend over its extra length which sticks out on the under side; hammer this down firmly, so that it becomes embedded in the grain of the wood.

When putting together the different parts of a toy, especially one that has movement, be very careful not to hammer in the nails to their full length until it is found that all the parts are correctly adjusted. (This rule applies equally to screws and cotter pins.)

When making a joint—either with a nail or cotter pin—be very careful to make the hole large enough to take the nail or pin easily. If this is not done, and the



nail or pin has to be forced through the hole, the wood will most probably split—especially if the hole is near the edge.

If a hole is wanted larger than that made by a single boring with the drill, bore four small holes in a group and finish with the point of the knife. This method is less likely to split thin wood than the use of a gimlet.

#### GLUING

Spread glue thinly, and if possible put under pressure till glue is set.

#### COLOURING

See that the wood has been made quite clean and smooth with glass-paper before putting on any paint.

#### POSTER OR SHOWCARD COLOURS

It is best to put these on rather thinly.

#### DYES

Aniline dyes can be bought in powder form to be mixed with water. The following are good colours: Rhodamine B. (crimson), Crocein Scarlet, Orange G., Auramine (yellow), Methylene Blue, Basic Green, Methylene Violet.

#### VARNISH

If a shiny and waterproof surface is wanted, use clear, colourless varnish, so as not to darken the colour unduly.

The following *Varnish* is useful:

- 9 oz. white or bleached shellac.
- 2 oz. borax.
- 3 gills water.

Boil together till the shellac is dissolved. Keep in corked bottle.

This varnish can be used with poster paint or dye instead of water: if used separately it must be put on lightly and thinly, with a soft brush, so as not to disturb the paint, which must be quite dry. The brush can be washed in soap and water, without the use of spirit.

A pleasant effect can be got by *burnishing*, i.e. rubbing the thinly painted surface with another piece of wood, till it is shining.

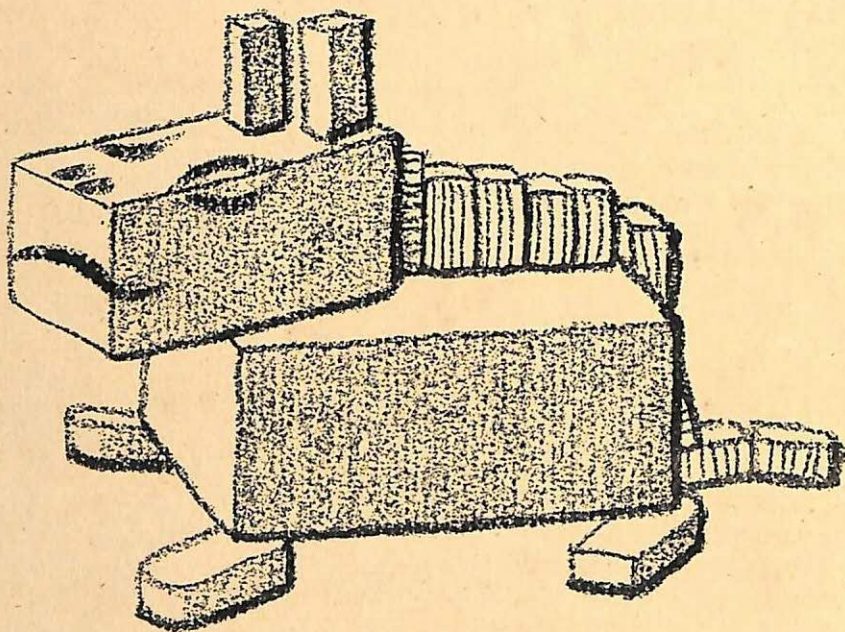
#### ENAMEL

This should be put on thinly. A thick coat gives a heavy, syrupy effect, which is not pleasant—especially in a toy.

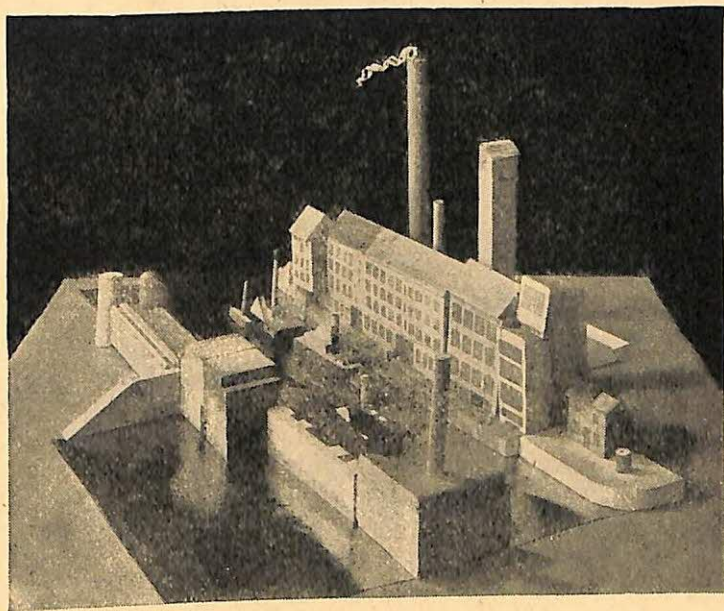
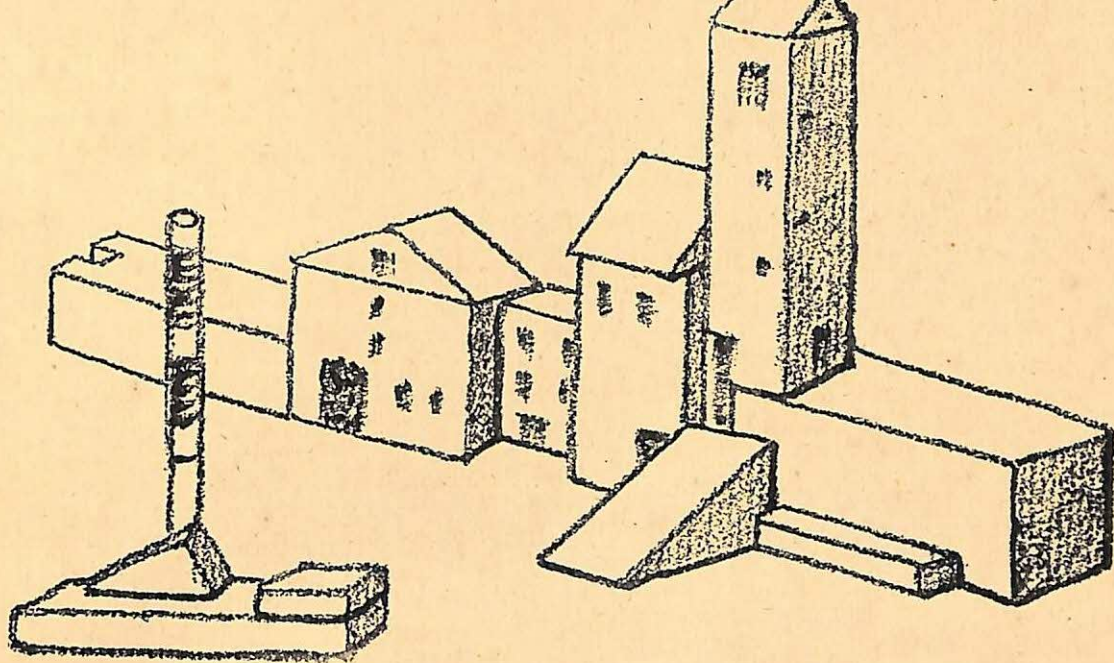
# TOYS BUILT UP FROM WASTE PIECES OF WOOD

## TOYS WITH NO TOOLS

The pieces are not fastened together and can be arranged and rearranged at will.







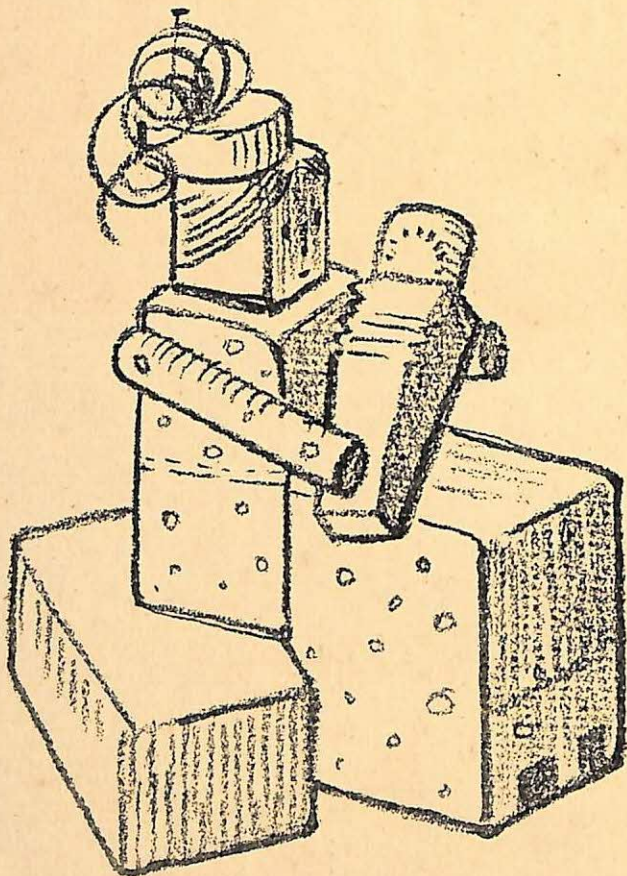
FACTORY AND DOCK BUILT UP FROM WASTE PIECES

## TOYS BUILT UP FROM WASTE PIECES OF WOOD

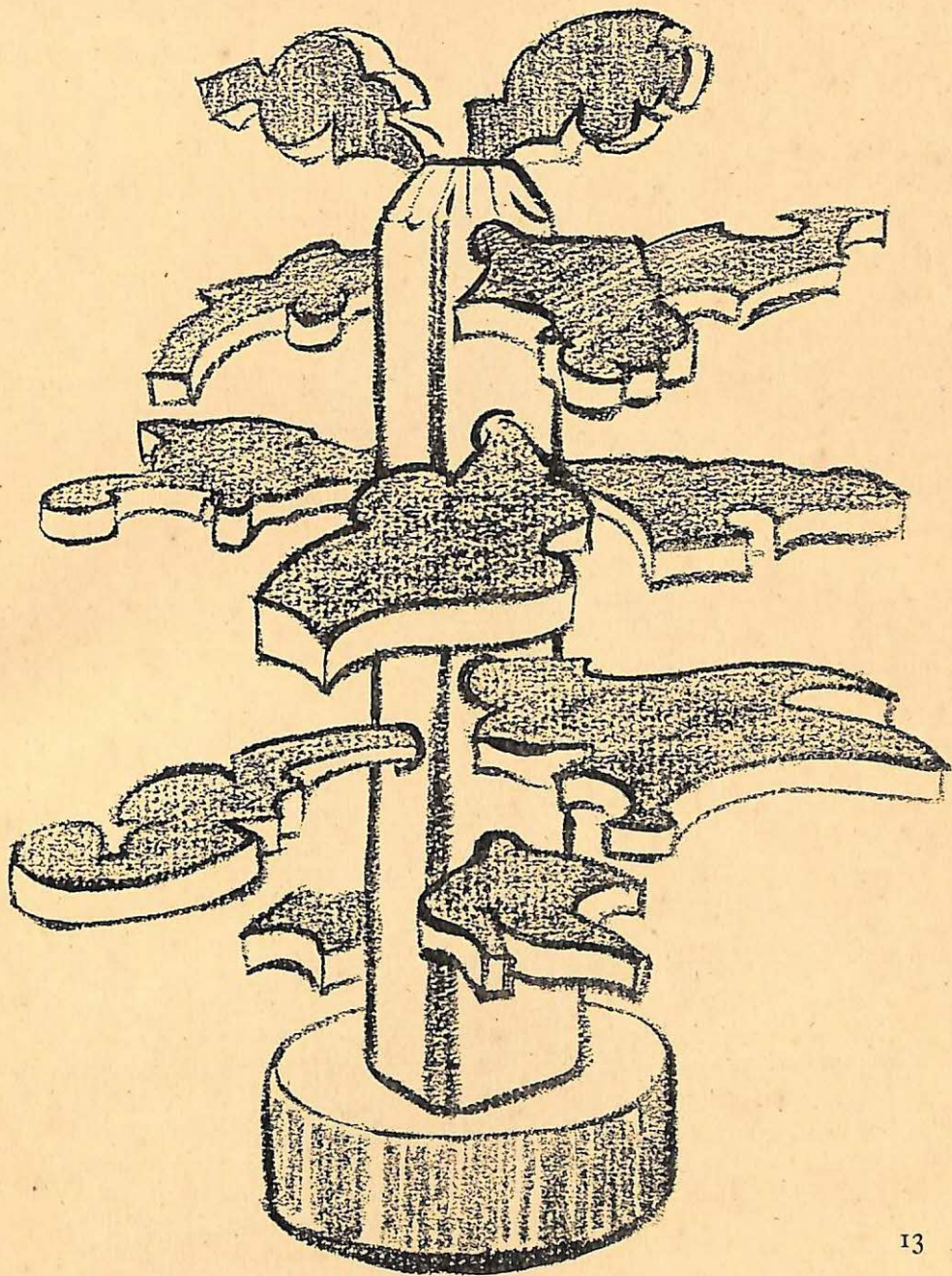
### TOYS WITH SLIGHT SHAPING

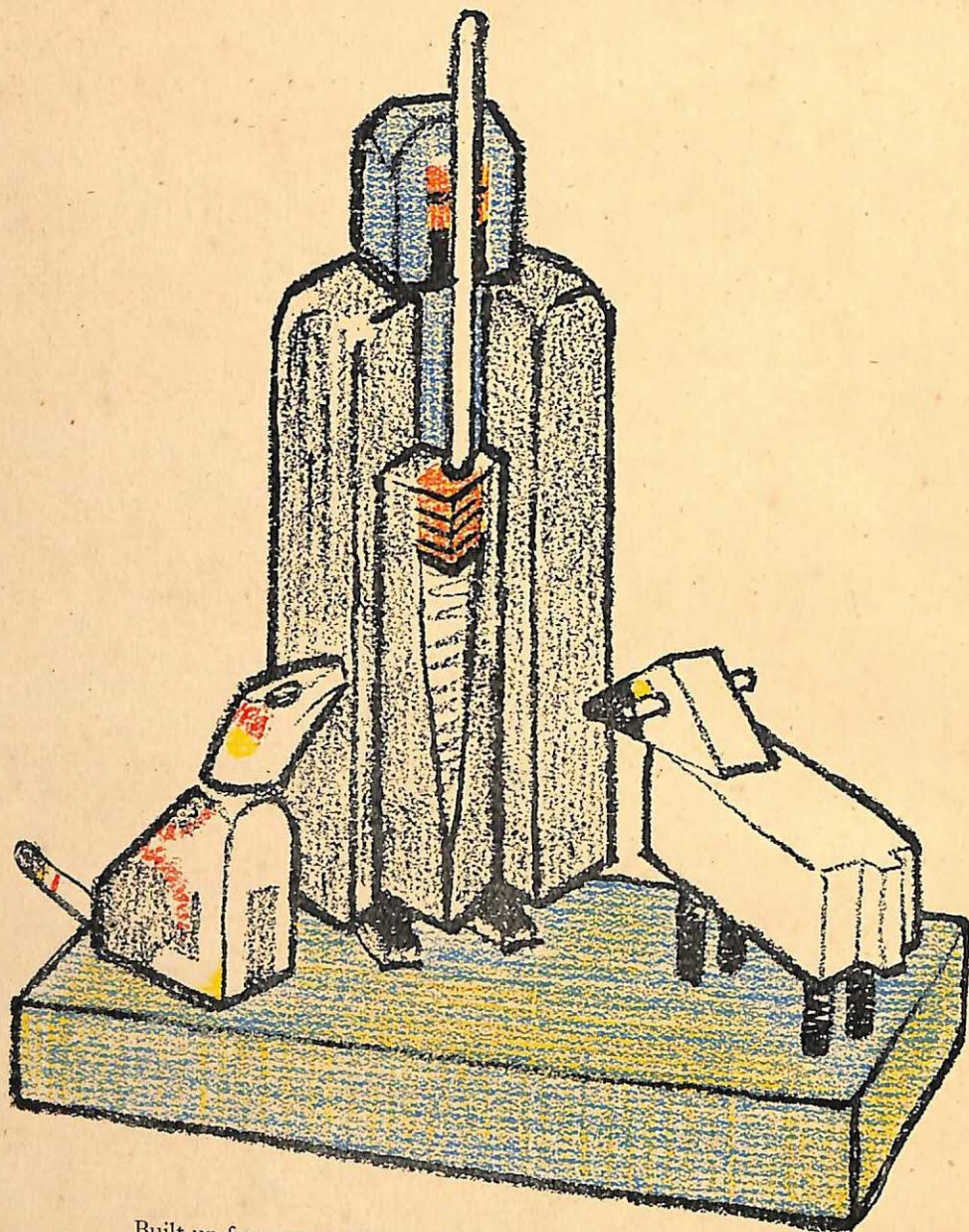
These toys were made while 'playing about' with odds and ends of wood; the shape of the pieces themselves suggested the design, and they needed only a little adjustment and a corner taking off here and there with a penknife, before gluing and nailing up.

A brace and bit were used for making the holes in the trunk of the tree in which to put the branches, and for fixing the stork's leg etc.



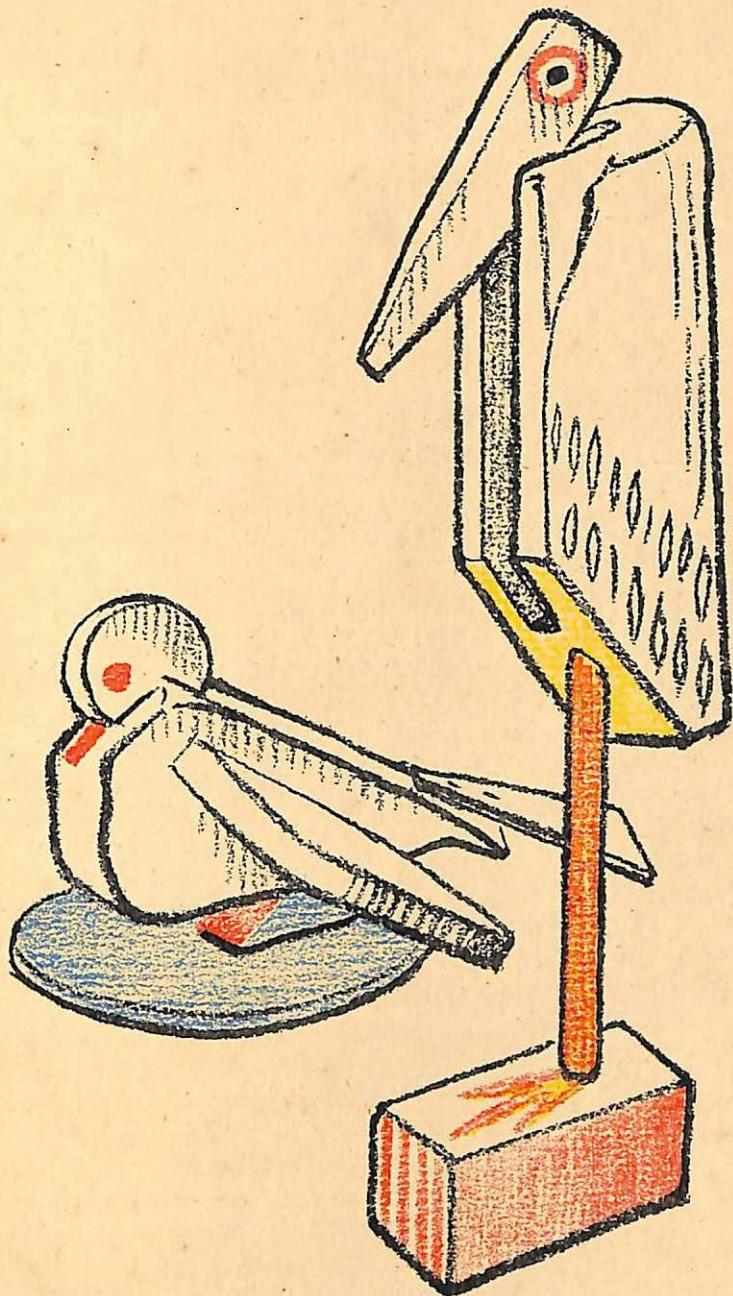






Built up from waste pieces of wood with slight shaping.





Built up from waste pieces of wood with slight shaping.

# TOYS DESIGNED AND SHAPED BEFORE BUILDING UP

## GROUP TOYS

## I. MARY AND HER LAMB

Figures, similar to these, can be used as units in a Group Toy, i.e. Noah's Ark or Farm; as group illustrations to a Fairy Tale or History Lesson, or for a Nativity Crib.

## TOOLS:

Fretsaw, Archimedean drill, hammer, knife.

## MATERIALS:

Wood  $12\frac{1}{2}$  in. by  $4\frac{1}{2}$  in. by  $\frac{3}{8}$  in. for Mary.

Wood 6 in. by 3 in. by  $\frac{3}{8}$  in. } for lamb.

Plywood 3 in. by  $1\frac{1}{2}$  in.

Wood 10 in. by 3 in. by  $\frac{3}{8}$  in. for stand.

Grain to run lengthwise.

Short length of fine string for handle of school satchel.

2 fine wire nails, flathead,  $\frac{3}{4}$  in. long.

4 panel pins,  $\frac{3}{4}$  in. long.

Glue.

Glass-paper.

Tracing paper.

Small piece felt or washleather for lamb's ears.

MARY, 7 in. high. This figure is made of three layers of wood, cut out separately and glued together, with the addition of two extra pieces for the arms (see Fig. 2).

## PROCEED THUS:

1. Draw the figure on paper. This drawing *must be in profile* (see Fig. 1), *not* a foreshortened three-quarter view, as in the illustration. Make three tracings of the drawing on tracing paper (see Fig. 3), test them to see that they correspond; make a tracing of the arm also. These are the Working Drawings, and must now be traced on the wood. Arrange them carefully according to the grain of the wood. (See Notes on Cutting, page 8.) If the figure is to be fitted into a stand, allow an extra  $\frac{3}{8}$  in. on the soles of the feet (see Fig. 3).

2. Cut out with fretsaw. Put the pieces together, see that the parts correspond, and make any necessary adjustments.

3. Glue and nail together the three body pieces—using  $\frac{3}{4}$  in. panel pins. Put under pressure till glue is set.

4. Shape the head and neck with the knife, as it should not be as wide as the shoulders (see Fig. 2). Shape the arms and legs if need be, but keep everything as direct and simple as possible. Do not aim at elaborate realistic carving.

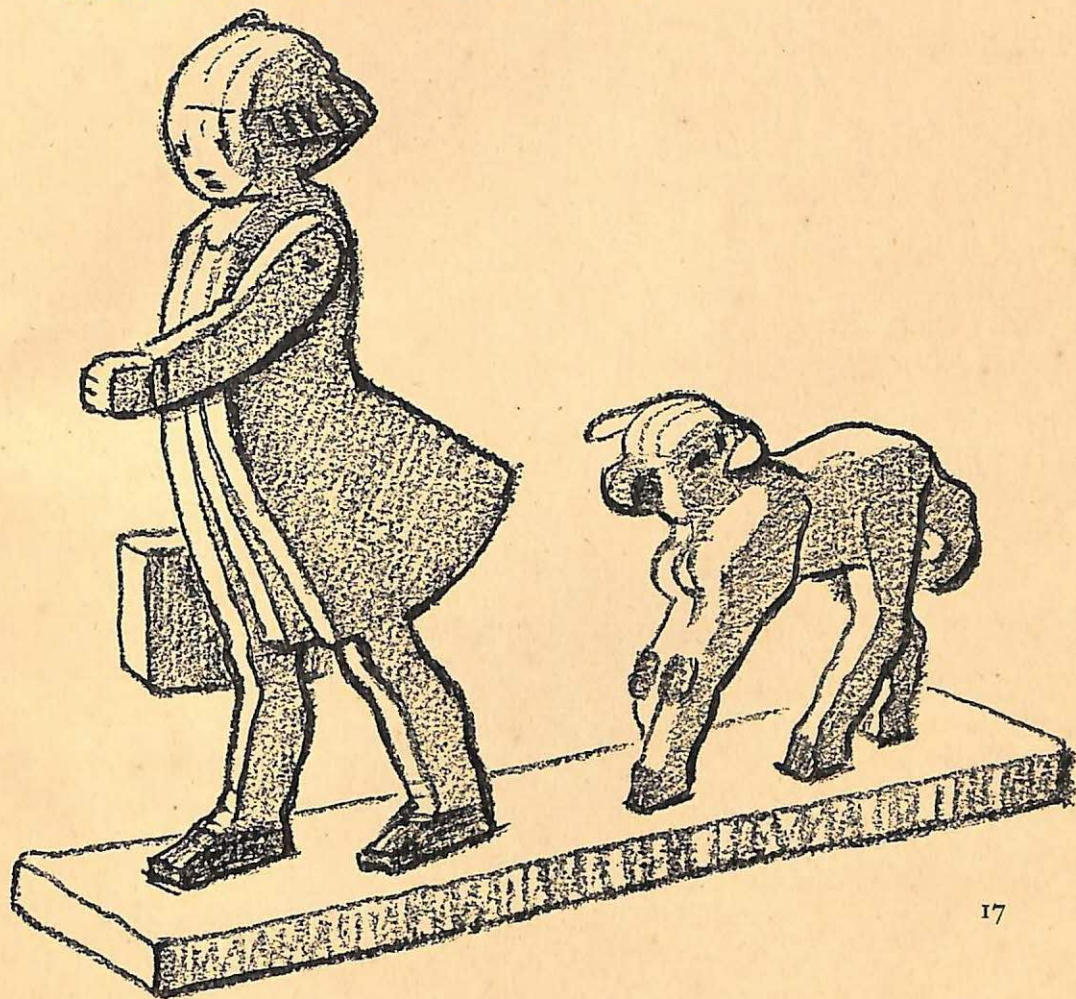
5. Bore a hole in the right hand to take the string handle of the school satchel, and bore a hole in each shoulder to take the  $\frac{3}{4}$  in. flathead nails which form the joints. Nail the arms in position.



6. The handle is made by boring two holes in the satchel top and inserting the ends of the string into them, making fast with a little glue. Thread the string through the hand before finishing the handle.

STAND. Put the finished figure in position and mark with a pencil the outlines of the two feet on the stand. Within these outlines cut holes with the fretsaw, taking care to keep the holes smaller than the feet. Trim the extra wood on feet, with a knife, to fit the holes and make firm, if necessary, with glue.

LAMB. This figure is made in the same way as 'Mary'. (For diagrams, see page 19.) The middle piece, to give better proportions, is made of three-ply wood. The ears are similar to the monkey's (see page 25).



# DIAGRAMS: MARY

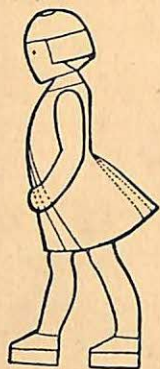


Fig. 1

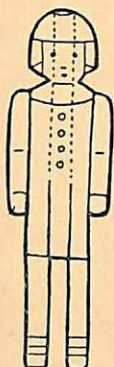


Fig. 2

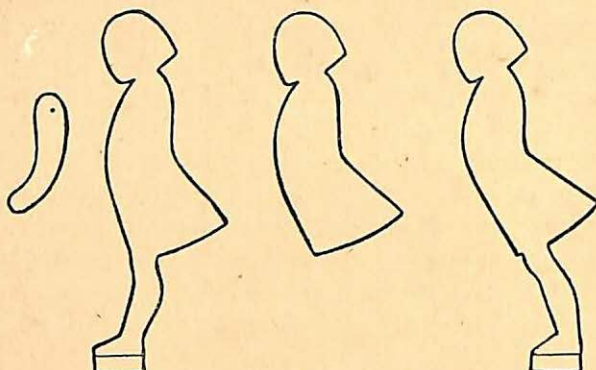
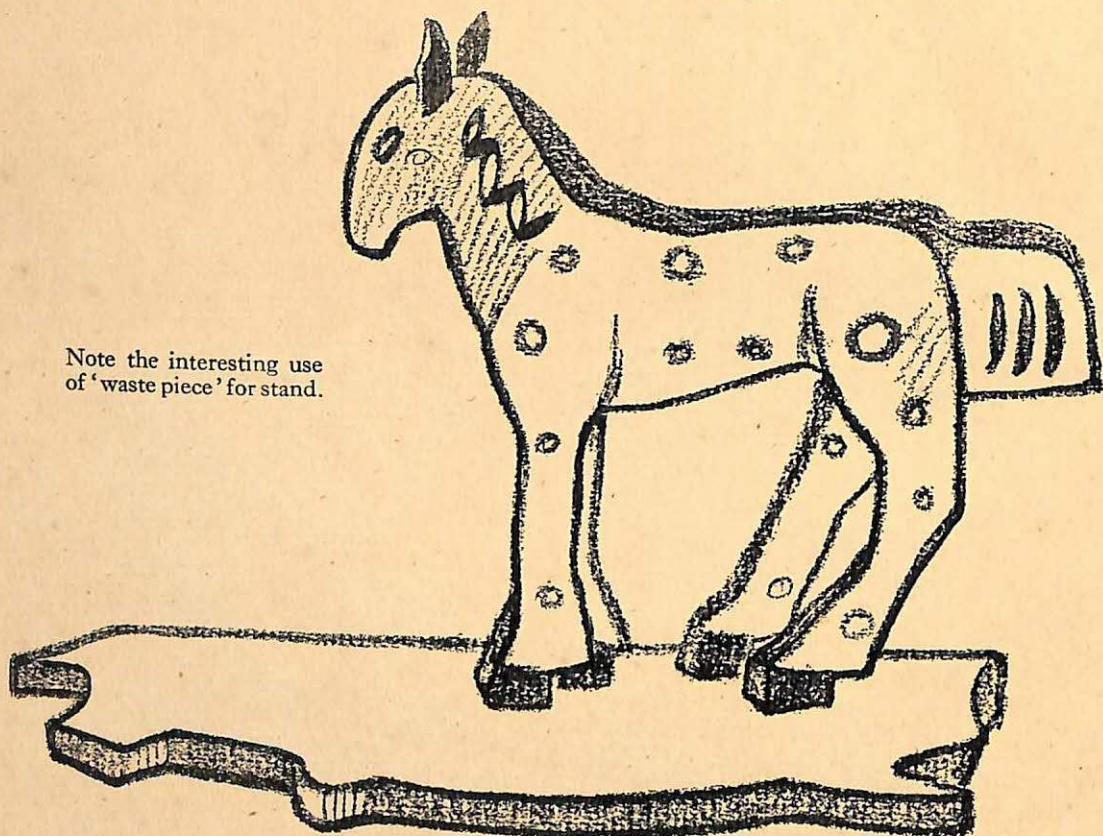


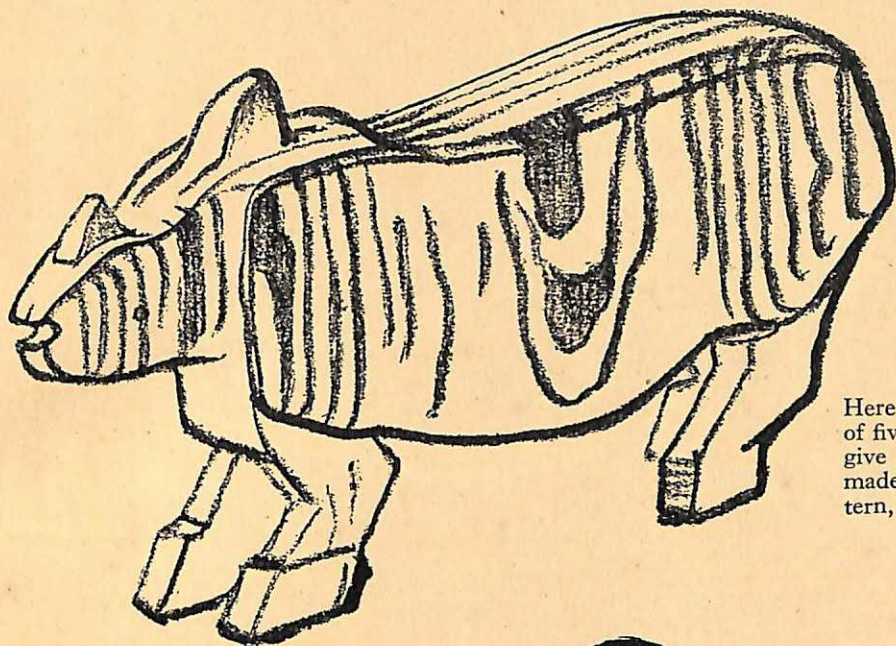
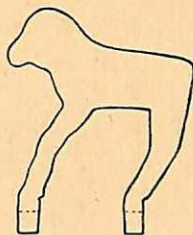
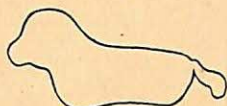
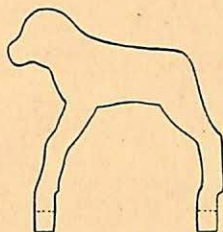
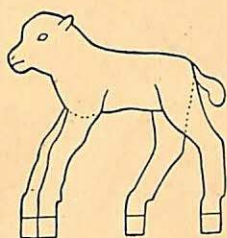
Fig. 3

Note the interesting use  
of 'waste piece' for stand.

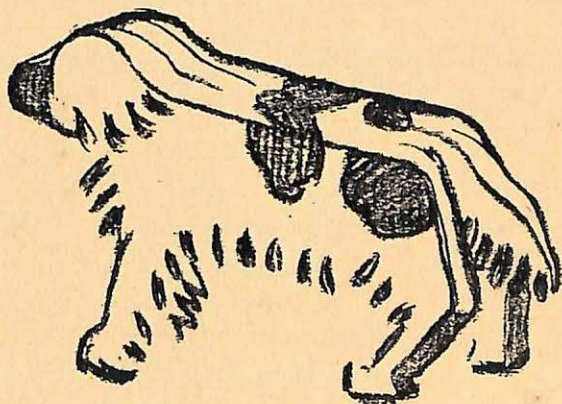




# DIAGRAMS: LAMB



Here the body was made of five layers of wood to give bulk. As the grain made an interesting pattern, no paint was used.



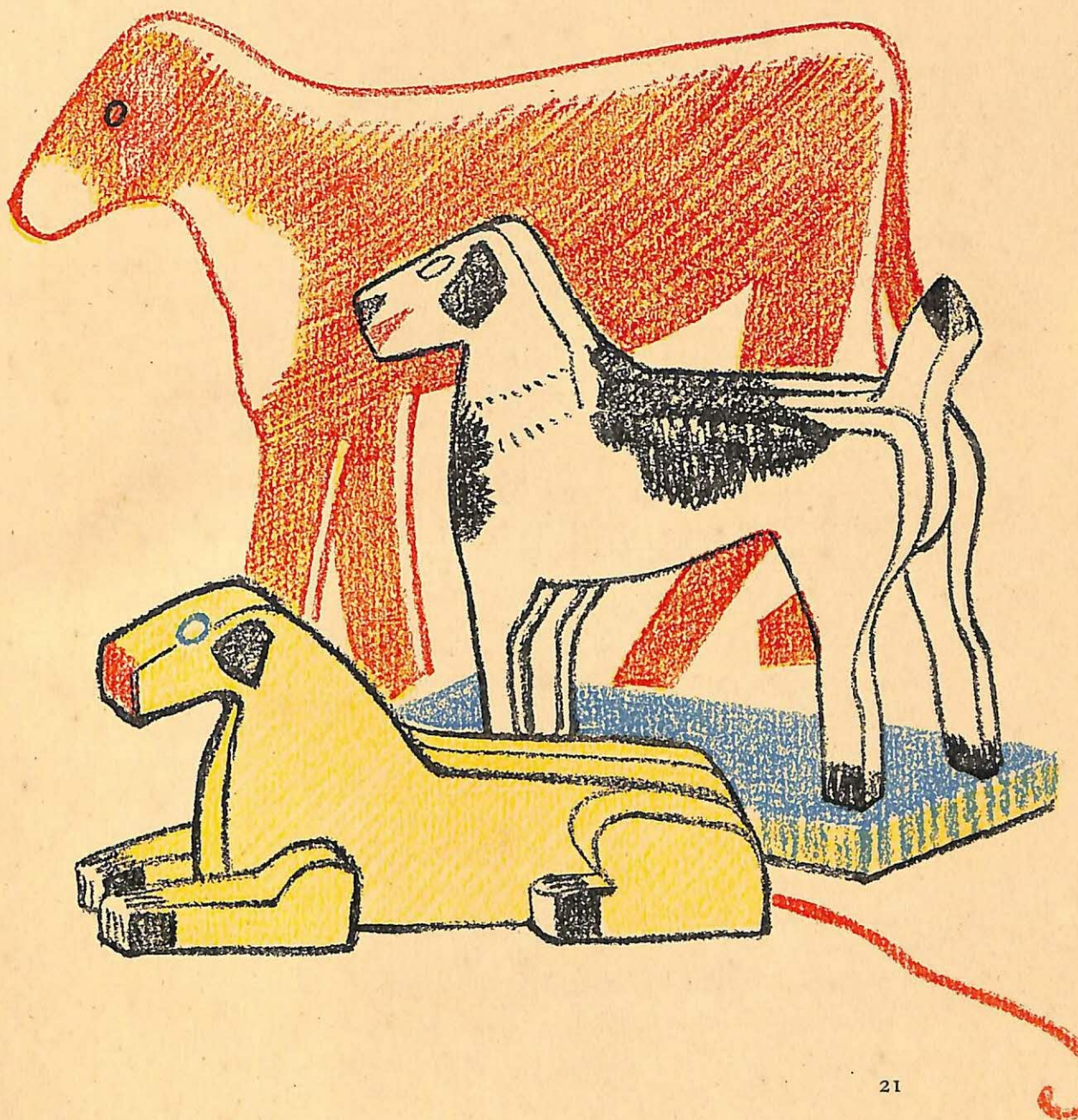
A pleasant variety was given here by very simple carving with a penknife, to suggest the shagginess of the coat.





The toys on these pages were made by students on lines similar to 'Mary and her Lamb'  
(see page 16).







## 2. DOLL. Height 7 in.

### TOOLS:

Fretsaw, Archimedean drill, knife.

### MATERIALS:

Wood  $6\frac{1}{2}$  in. by 3 in. by  $\frac{3}{8}$  in. for limbs.

Grain to run lengthwise.

4-in. length broomstick or dowel, 1 in. diameter,  
for head and body.

Fine string for joint.

Tracing paper.

Glass-paper.

### PROCEED THUS:

1. HEAD AND BODY. Mark off two lines on broomstick—(a) 1 in. from end, to give line of chin and hair; (b)  $1\frac{1}{4}$  in. from end, to give line of shoulders. With knife shape the head and shoulders (see illustration).

2. Shape the body by shaving off some of the thickness at the shoulders and hips, where the joints will come. This will give a better proportion to the figure, and the joints will work better on the flat surface.

3. Make Working Drawings of limbs (see page 16, par. 1), trace them on wood and cut out with fretsaw. Shape the limbs by shaving off some of the thickness on the outside of top of hip and on the outside of shoulders. Shape the hands (see illustration). This will allow them to pass easily over hips.

4. Bore holes to take the string joints at the shoulders and hips, and bore corresponding holes through the body. These holes should be smooth and large enough to take the string without fraying it.

5. ARM JOINTS. (1) Double string and pass loop through armhole from outside (see Fig. 1).

(2) Separate strings and pass them round arm, bringing both ends through loop and pull tight (see Fig. 2).

(3) Thread both ends through body and other arm.

(4) Separate strings as before and pass round outside of arm, but thread *one only* between strings that come out of body. Pull tight and neat, and tie up both ends in a firm knot.

Make the hip joints in the same way.



# DIAGRAM: STRING JOINT

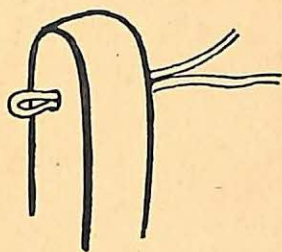


Fig. 1

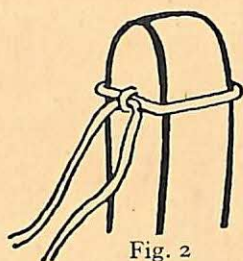
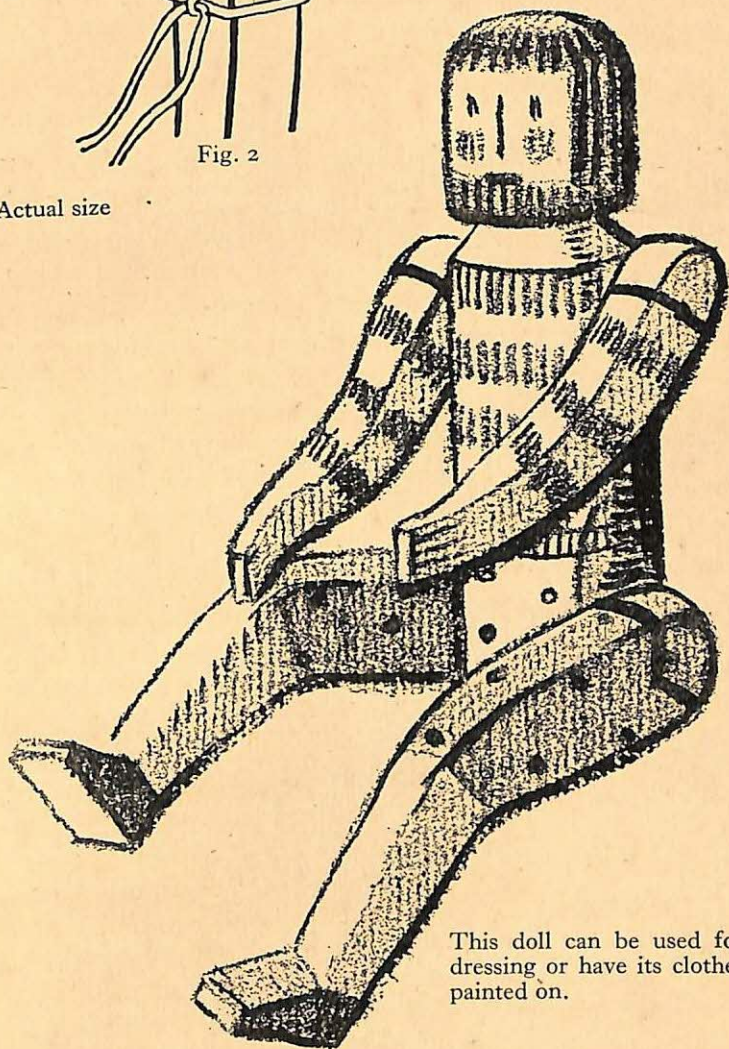


Fig. 2

Actual size



This doll can be used for dressing or have its clothes painted on.

# TOYS WITH SIMPLE MOVEMENT

## 1. MONKEY-ON-A-STICK

### TOOLS:

Fretsaw, knife, Archimedean drill, hammer

### MATERIALS:

Wood about  $3\frac{1}{2}$  in. by  $1\frac{1}{2}$  in. by  $\frac{3}{8}$  in. for body. Grain to run lengthwise.

Plywood about  $3\frac{1}{2}$  in. by 3 in. for limbs.

1 dowel  $\frac{3}{8}$  in. diameter, 15 in. long } for  
1 dowel  $\frac{1}{8}$  in. diameter, 18 in. long } sticks.

Glass-paper.

Tracing paper.

4 fine cotter pins, 1 in. long.

1 screw-eye.

Piece of thick, soft string about 4 in. long, for tail.

Washleather or felt for ears.

Glue.

### PROCEED THUS:

1. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw.

2. Bore holes for the four cotter pins that fasten the body and limbs together and the limbs and sticks together. Care must be taken when boring these holes: (a) to get them in a straight line, so that the pins can be inserted without bending; (b) to make them large enough to give the joints easy movement. The holes in the sticks should be  $\frac{1}{2}$  in. from the ends.

3. Put in position the two pins that fasten the legs and arms to body, but do not finally fix them.

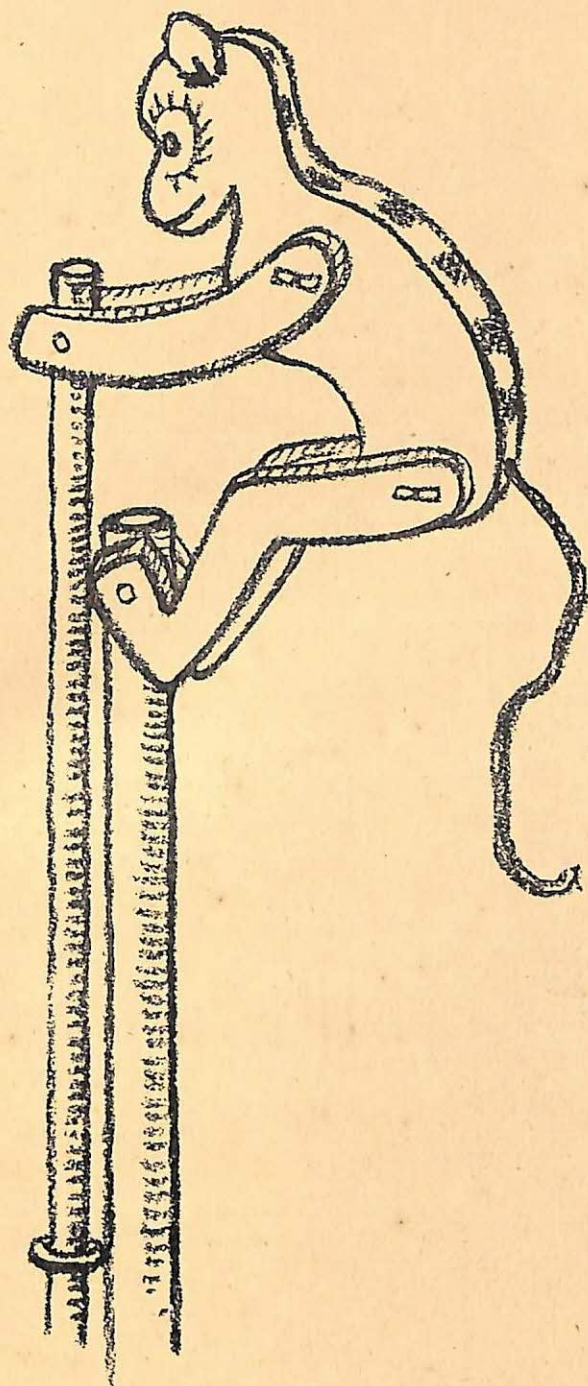
4. Fix the tail by boring a hole and pressing into it one end of the string, making it fast with a little glue. The ears, which are in shape a diamond with a rounded top, can be fixed by pressing the points either into a bored hole or a slit made with the knife and making fast with glue.

5. Now the monkey can be put on the sticks. Fix the thicker stick between the monkey's feet with a cotter pin. This stick holds the screw-eye through which the thinner stick runs. The screw-eye should be placed 8 in. from the top of the stick and should face exactly to the front. Bore a hole a little way into the dowel to start the screw.

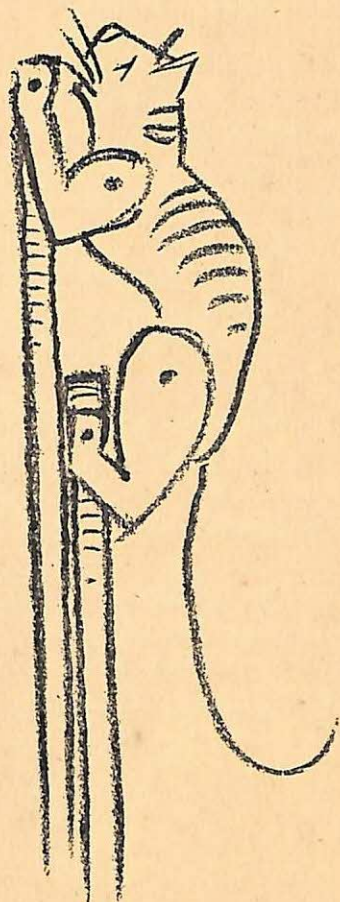
6. Pass the thinner stick through the screw-eye before it is fixed with a cotter pin between the monkey's hands.

7. Test the movement of the toy, make any necessary adjustments and colour it before finally flattening out the cotter pin ends.





SUGGESTION:  
Cat and Tree.



## 2. WRESTLERS

### TOOLS:

Fretsaw, Archimedean drill, hammer.

### MATERIALS:

Wood 14 in. by 4 in. by  $\frac{3}{8}$  in. for two heads and bodies, four arms, four upper legs.  
Grain to run lengthwise.

Plywood  $5\frac{1}{2}$  in. by  $2\frac{1}{2}$  in. for four lower legs.

8 nails, flathead,  $\frac{3}{4}$  in. long.

2 panel or veneer pins,  $\frac{3}{4}$  in. long.

4 cotter pins, 1 in. long.

4 yards string.

Glass-paper.

Tracing paper.

### PROCEED THUS:

1. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw.

2. In two of the arms bore a hole  $\frac{3}{8}$  in. from each end and another about 1 in. away from the one at the shoulder end. These two arms will be the right arms of the figures.

3. In the remaining two arms bore a hole at the shoulder ends.

4. In the four upper legs bore a hole  $\frac{3}{8}$  in. from each end, and in each plywood lower leg bore a hole  $\frac{3}{8}$  in. from the top end.

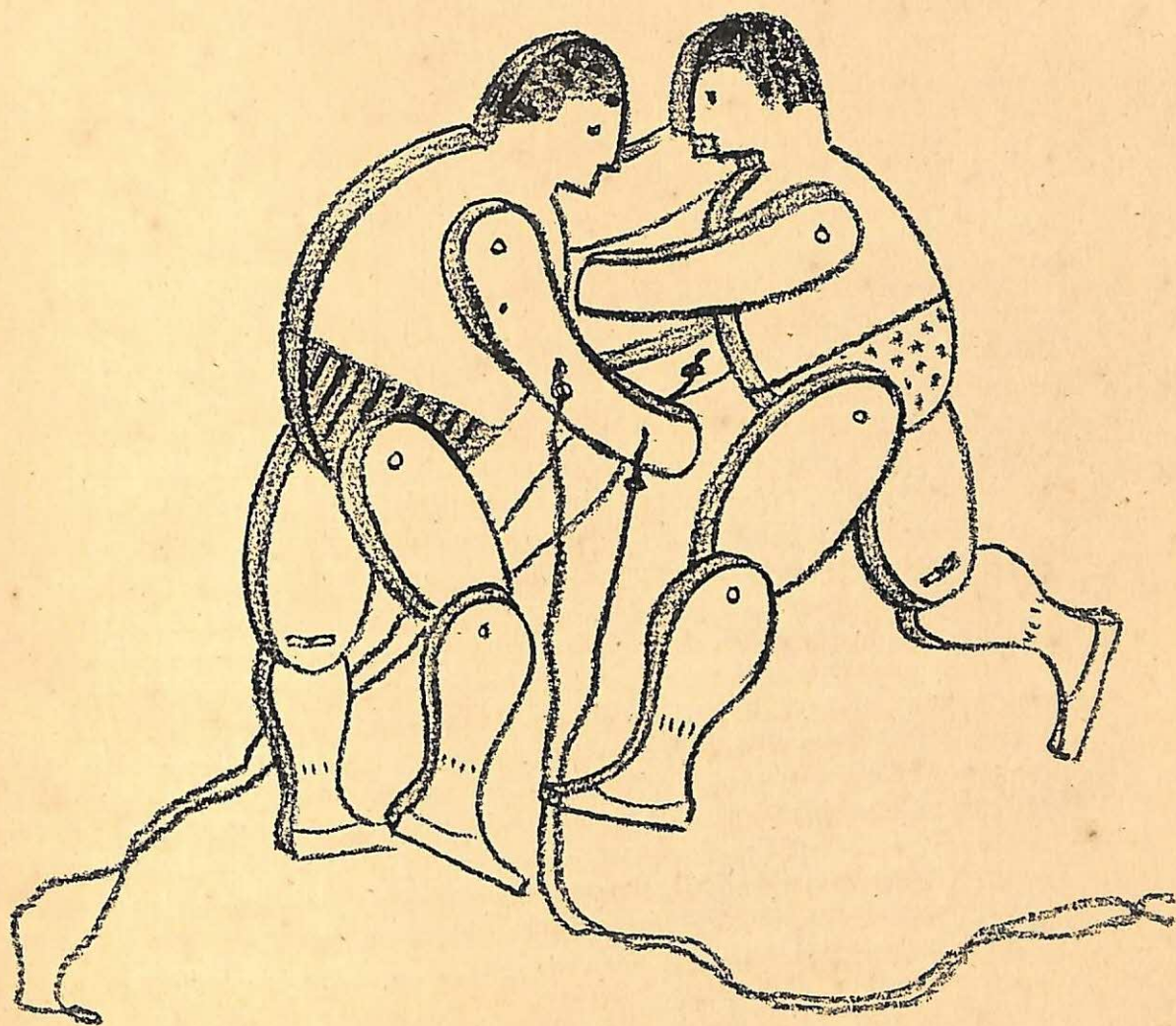
All holes must be large enough to allow the nails or cotter pins (which form the joints) easy play, so that the limbs will move freely when the strings are jerked.

5. Make each knee joint with a cotter pin; then nail the legs and arms on the bodies. Do not drive the nails fully home; this can be done, if necessary, when the movement has been tested and the colour put on.

6. Cut the string in half and thread it through the right arm of each figure, as seen in the illustration. Note the knots which keep the figures in position in the centre of the strings. Make the *right* arms rigid, by nailing them to the body with a panel pin in addition to the nail already used.

The figures are worked by holding the string at one extremity and jerking it, the other extremity being held steady by a partner or put round a door knob etc.





### 3. GYMNAST

#### TOOLS:

Fretsaw, Archimedean drill, hammer.

#### MATERIALS:

Wood 3 in. by  $1\frac{1}{4}$  in. by  $\frac{3}{8}$  in. for body.

2 strips 8 in. by 1 in. by  $\frac{1}{4}$  in. } for

1 strip  $2\frac{1}{2}$  in. by 1 in. by  $\frac{3}{8}$  in. } stand.

Grain to run lengthwise.

Plywood 3 in. by 2 in. for limbs.

2 cotter pins, 1 in. long.

2 nails, flathead,  $\frac{3}{4}$  in. long.

Fine string, about 8 in. long.

Tracing paper.

Glass-paper.

#### PROCEED THUS:

1. FIGURE. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw. Note that the total length of the figure with arms outstretched is  $4\frac{3}{4}$  in.

2. Bore holes in the legs and arms  $\frac{3}{8}$  in. from the end for the hip and shoulder joints. These holes must be large enough to allow the cotter pins (which form the joints) easy play, so that the limbs will move freely.

3. In each hand end of the arms, bore two parallel holes for string (see Fig. 1).

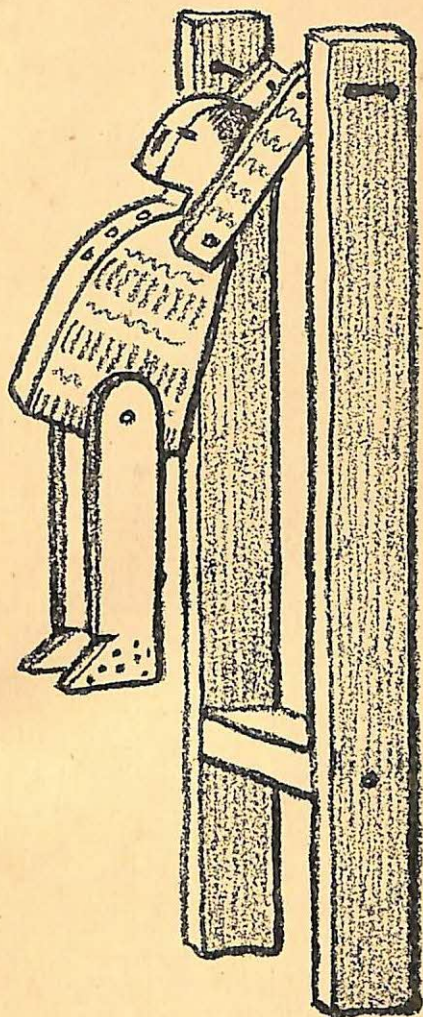
4. Bore a hole through the body at the hips and shoulders, for the joints. Take care that these holes are in a line with those already made in the legs and arms, so that the pins can be inserted without bending. Test these joints for easy movement before finally flattening out pin ends.

5. STAND. Bore a hole in each 8-in. strip, 3 in. from the end. These are for the nails which hold the crosspiece (see illustration).  $\frac{3}{8}$  in. from the other end of each strip bore two parallel holes to take the string (see illustration).

6. Place crosspiece in position, i.e.  $2\frac{3}{4}$  in. from the foot of the stand, and hammer the two uprights on it. Thread the string through the uprights and hands (see Fig. 2). The uprights should be parallel when the string is fixed.

The figure is worked by pressing together and relaxing the two lower ends of the uprights.





GYMNAST



Fig. 1

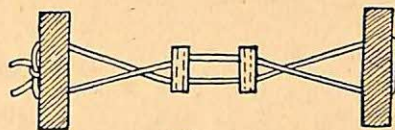
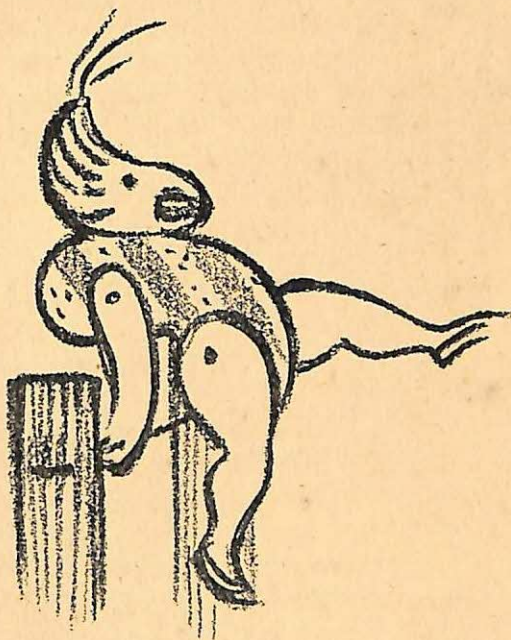


Fig. 2

BIRD'S EYE VIEW



SUGGESTION—  
not worked out

#### 4. ACROBAT

##### TOOLS:

Fretsaw, Archimedean drill, hammer, knife, round-nosed pliers and wire-cutter, file.

##### MATERIALS:

|   |  |
|---|--|
| Wood $3\frac{1}{4}$ in. by $3\frac{1}{4}$ in. by 1 in. for stand.                     | Glass-paper.                                       |
| Wood $6\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{3}{8}$ in. for body and legs. | Tracing paper.                                     |
| 2 strips 8 in. by 1 in. by $\frac{1}{4}$ in. for uprights.                            | $5\frac{1}{2}$ in. or 6 in. tinned wire, 18 gauge. |
| Grain to run lengthwise   | 2 nails, flat top, $\frac{3}{4}$ in. long.         |
| Plywood $3\frac{1}{2}$ in. by $1\frac{1}{2}$ in. for middle piece of body.            | 1 fine cotter pin, $1\frac{1}{4}$ in. long.        |
| 2 lengths dowel $\frac{3}{8}$ in. diameter, $2\frac{1}{2}$ in. long for arms.         | 8 fine panel pins, $\frac{3}{4}$ in. long.         |
|   | Glue.  |
|   | Small cork or short length of dowel for knob.      |
|   | Feather for cap.                                   |

##### PROCEED THUS:

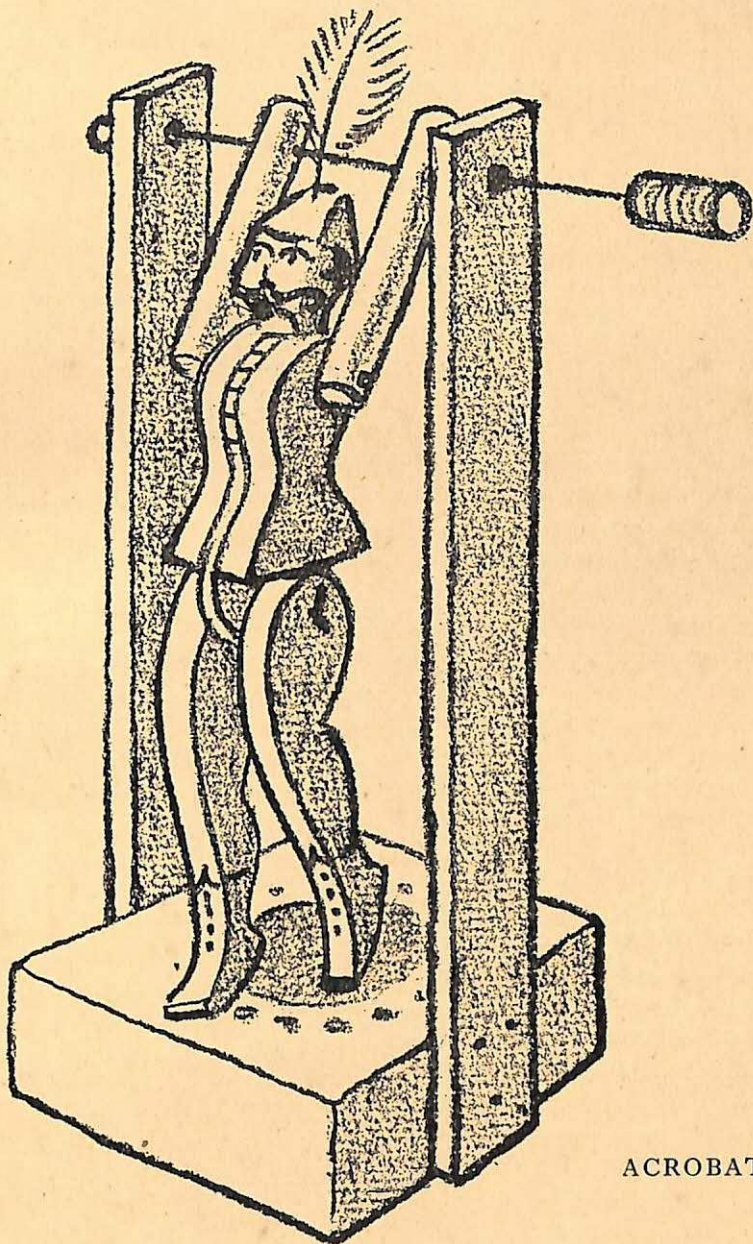
1. FIGURE. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw. The total length of the figure, with arms outstretched, is 7 in.
2. Make up the body as on page 16, shaping the head with the knife.
3. Bore a hole through the top of each leg and the projecting piece of plywood on body. These holes are for the cotter pin joint. They must be large enough to allow for free play on the pin, and they must be in a straight line, so that the pin can be passed through without bending. Test the movement of legs before finally fixing pin.
4. Bore a hole about  $\frac{3}{8}$  in. from each end of the two arm pieces. Note that the holes that are to take the nails which form the shoulder joint should be large enough to allow easy movement, but the holes at the hand end should be only *just* large enough to take the wire.
5. Nail on the arms at the shoulders, but do not hammer the nails quite home. Test for freedom of movement.
6. STAND. Bore three small holes at the lower end of each upright and one hole, large enough to take the wire easily, at the upper end of each upright.
7. Place the uprights in position; they should be exactly parallel when fixed, so make any necessary adjustments before gluing and nailing up with panel pins.
8. With the round-nosed pliers make a small loop at one end of the wire; this is to keep it from slipping back through the hole when the figure is worked.
9. Put the wire through both holes and mark on it the position of the hands. With the file roughen the wire on these marks. This will help the wire and wood to grip, *which is essential.*





10. Note the position of the loop-end and knob-end in illustration. Pass the wire through the uprights and hands, making the hands and knob fast on the wire with a little glue.

The figure is worked by twisting the knob, but do not do this till the glue has had time to set!



ACROBAT



#### 4. MAID 'HANGING OUT THE CLOTHES'

This is a similar toy to the 'Acrobat', but in this case the figure does not move when the knob is twisted—only the clothes are agitated.

##### TOOLS:

Fretsaw, Archimedean drill, hammer, file, saw, pair of compasses, knife, round-nosed pliers and wire cutter.

##### MATERIALS:

|   |  |
|---|--|
| Wood 7 in. by 3 in. by $\frac{3}{8}$ in. for stand.   | 10 panel pins, $\frac{3}{4}$ in. long.                             |
| 2 lengths $4\frac{1}{2}$ in. by $\frac{3}{4}$ in. by $\frac{3}{4}$ in. for uprights.          | 2 screw-eyes.  |
| Wood 5 in. by 5 in. by $\frac{3}{8}$ in. for skirts of maid.                                  | 6 nails, flathead, 1 in. long.                                     |
| Plywood about $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. for arms.                              | 2 nails, flathead, $\frac{1}{2}$ in. long.                         |
| $2\frac{3}{4}$ in. length broomstick or dowel, 1 in. in diameter, for head and body and legs. | 2 corks, for bird's body and knob.                                 |
| Glass-paper.  | 8 in. length of tinned wire, 18 gauge.                             |
| Tracing paper.  | 3 small pieces thin bright coloured paper or material for clothes. |
| Glue.   | Piece of postcard.   |
|   | Nail or wire to support bird.                                      |

##### PROCEED THUS:

1. FIGURE. Saw the length of broomstick into two pieces,  $\frac{3}{4}$  in. for the legs and the remaining 2 in. for the head and body. Shape the head and shoulders with knife (see illustration).

2. The skirts of the figure are made of four circles cut with fretsaw out of the 5-in. by 5-in. wood: A  $1\frac{3}{4}$  in. diameter; B 2 in. diameter; C and D  $2\frac{1}{2}$  in. diameter. Nail up in this order, using panel pins and boring the holes first: A to body; D to legs; C to D; B to C; A (with body attached) to B.

3. Cut out the arms with fretsaw and bore a hole at each end of each arm. The holes at the hand ends must be large enough for the wire to run through them easily. Nail the arms to body at shoulders, using  $\frac{1}{2}$  in. nails.

4. STAND. Place the uprights in position—they should be exactly at right-angles to the stand, so make any necessary adjustments with knife or file before gluing and nailing up. Use two 1 in. nails for each upright. When glue has quite set, screw in a screw-eye on top of each. (It is as well to bore the holes for these and for the bird's leg before fixing the uprights on stand.)

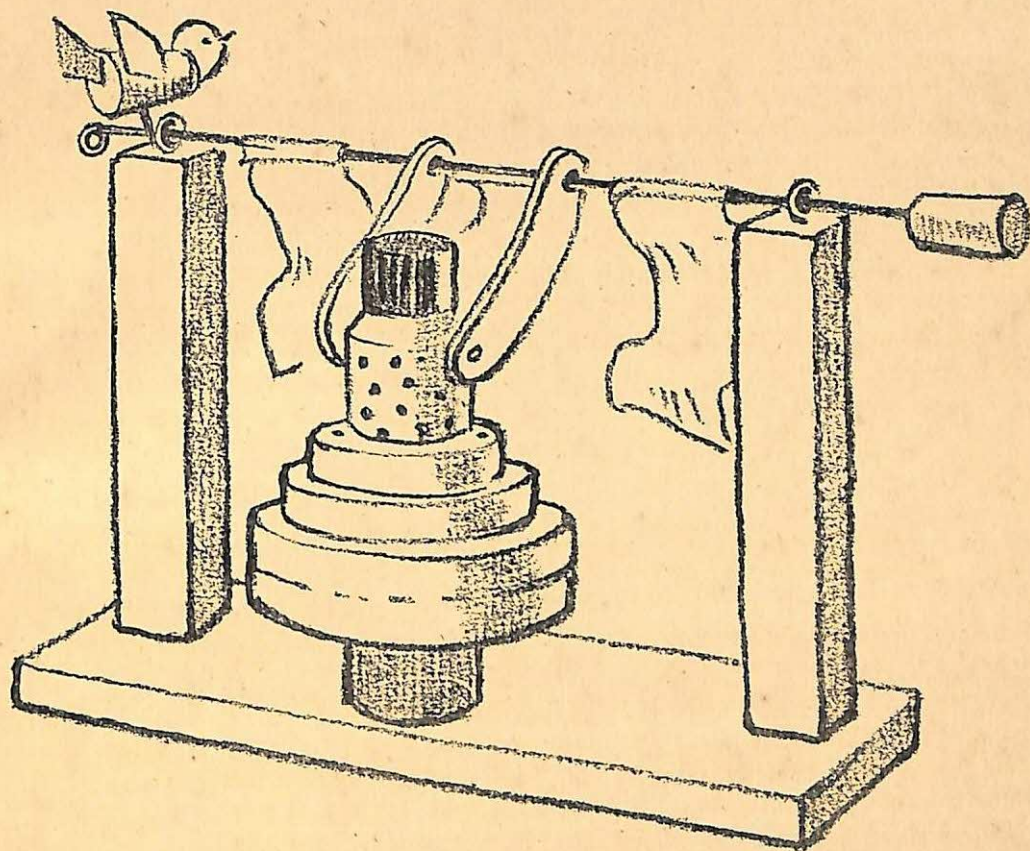
5. Put the wire through the screw-eyes and hand-holes with a loop at one end and a knob at the other (see illustration).

6. Mark the position of legs of maid on stand; glue and nail her in place, using two 1-in. nails.



7. Glue the strips of paper or material round the wire, which can be roughened with the file if there is any difficulty in getting the paper to stick.

8. The body of the bird is made of cork—the wings, head and tail of postcard. These are inserted into slits made with the knife and made fast with glue. The bird is poised on a nail or short length of wire.



## 5. MAN AND FISH, ON PARALLEL STRIPS

### TOOLS:

Fretsaw, Archimedean drill, hammer.

### MATERIALS:

Wood 6 in. by 6 in. by  $\frac{3}{8}$  in. for man and fish.

2 strips 12 in. by 1 in. by  $\frac{1}{4}$  in. for parallels.

Small piece plywood for arm.

Tracing paper.

Glass-paper.

Fine string about 15 in. long.

4 nails, flat top, 1 in. long.

1 nail, flat top,  $\frac{1}{2}$  in. long.

Small staple.

Small weight to keep string taut.

### PROCEED THUS:

1. Trace the outlines of your drawing of man and fish on wood and cut out with fretsaw. Cut arm out of plywood.

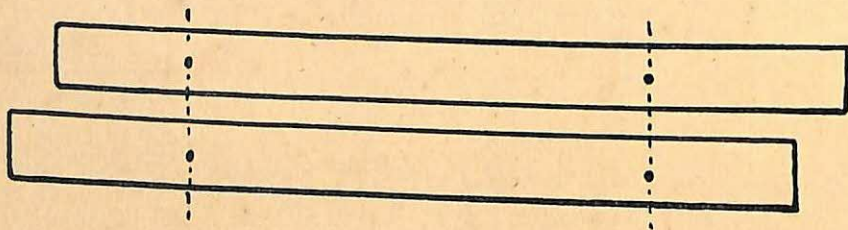
2. Bore hole in fish's nose and one at each end of man's arm. Nail arm to shoulder, using  $\frac{1}{2}$ -in. nail. Allow arm to move freely.

3. To fix figures on parallel strips: place the strips as you see in the diagram, the upper one,  $\frac{3}{4}$  in. to the right of the lower one, and separated from it by  $\frac{1}{4}$  in. to  $\frac{3}{8}$  in. Bore four holes in these strips as indicated in the diagram below, exactly above each other and in the centre of the strips.

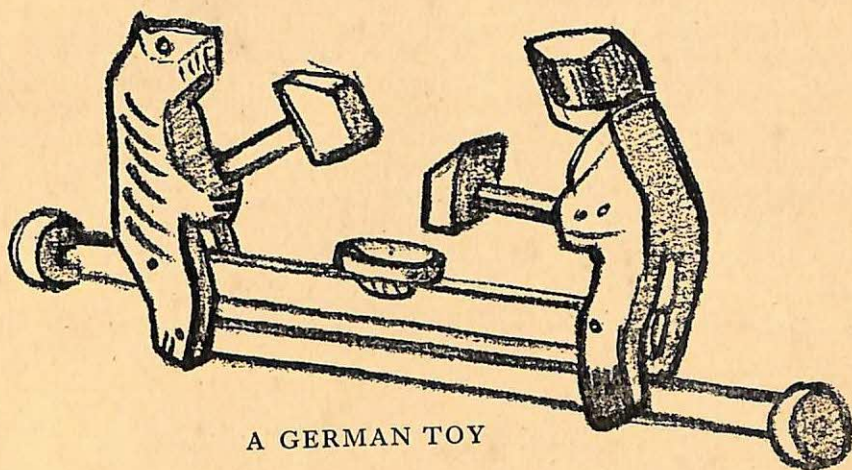
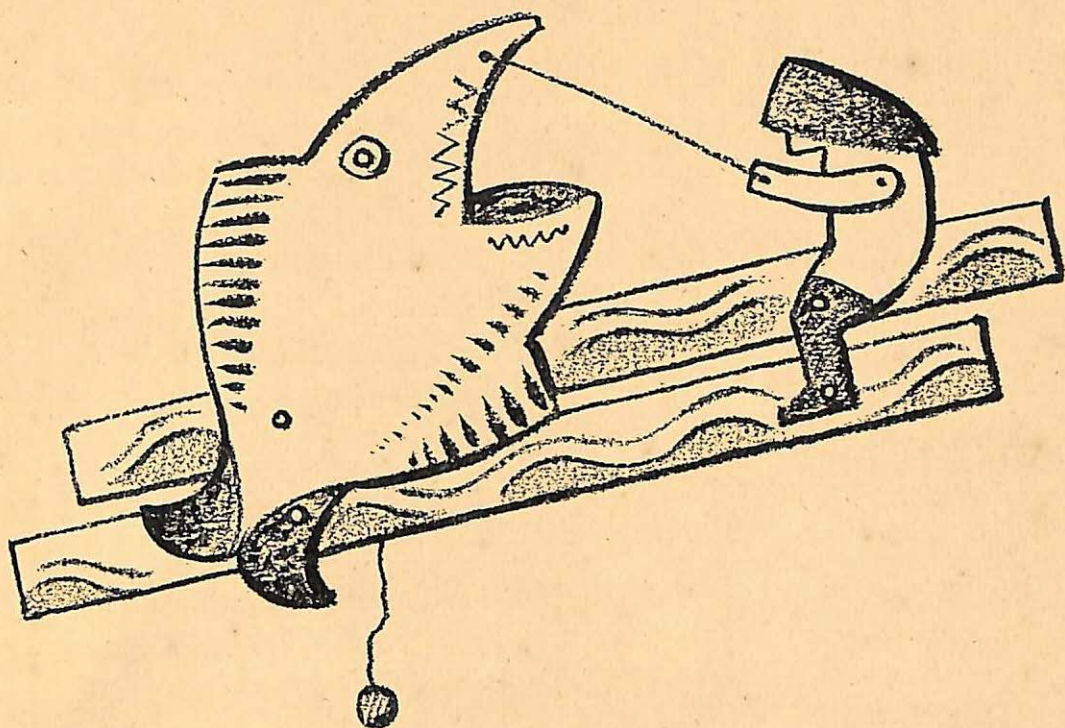
4. Bore holes in the figures to correspond to the holes in the strips; nail the figures on the strips, clenching the nails (see instructions on page 8) to hold them. The strips should move freely from side to side on the nails.

5. Now thread the string through the hand and fish's nose, passing it through a staple at the back of the fish to hold it in position, and fix weight on end to keep it taut.

The toy is worked by pulling the strips sideways in opposite directions—when the two figures will pursue each other in turn.







A GERMAN TOY

## 6. BIRD WITH NODDING HEAD AND TAIL

### TOOLS:

Fretsaw, Archimedean drill, hammer, knife.

### MATERIALS:

Wood  $7\frac{1}{2}$  in. by  $3\frac{1}{2}$  in. by  $\frac{3}{8}$  in. for bird.

Wood 8 in. by  $1\frac{1}{2}$  in. by  $\frac{3}{8}$  in. for stand.

Grain to run lengthwise.

Glass-paper.

Tracing paper.

About 6 panel or veneer pins,  $\frac{3}{4}$  in. long.

12 in. length fine string.

9 in. length fine string.

Glue.

Large bead or short length of dowel.

### PROCEED THUS:

1. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw. (Note the arrangement of the pieces according to the grain, to prevent breaking. See Fig. 1.) If the bird is to have a fixed tail, cut the body and tail in one piece; if the tail is to move, cut the body and tail in separate pieces, leaving out the part that is shaded.

2. See that the parts correspond, as in Fig. 2, and shape further if necessary.

3. Glue and nail body to wing A; the dotted lines indicate correct position (see Fig. 1).

4. Bore holes in the neck and tail pieces to take easily the panel pins that form the joints. Shave off some of the thickness of these pieces, so that they will move freely when in position between the two wings. Fix strings by inserting into small holes (see Fig. 2), making fast with glue.

5. Nail neck and tail in position to wing A, but see that they move easily on the pins when strings are pulled. Lay wing B in position, but test the movement of head and tail before finally gluing and nailing it up.

6. STAND. Cut out three holes in this with fretsaw: two for the strings, and one for the leg. The leg hole should be slightly smaller than the leg itself, the end of which should be trimmed to fit the hole.

7. Fit the leg into the body (shaping it if necessary), then into the stand, making it secure with glue. Pass the strings through holes in stand, knot them together, so that the movement is nicely balanced, and finish off with bead or short length of dowel.



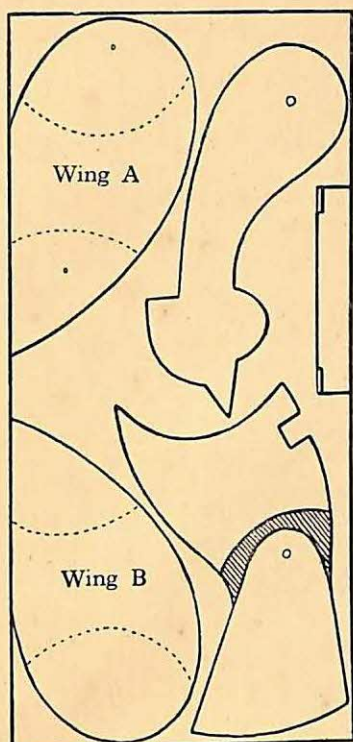


Fig. 1

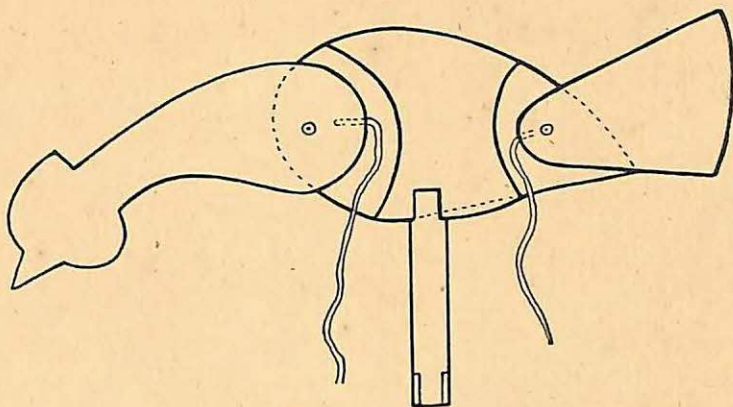
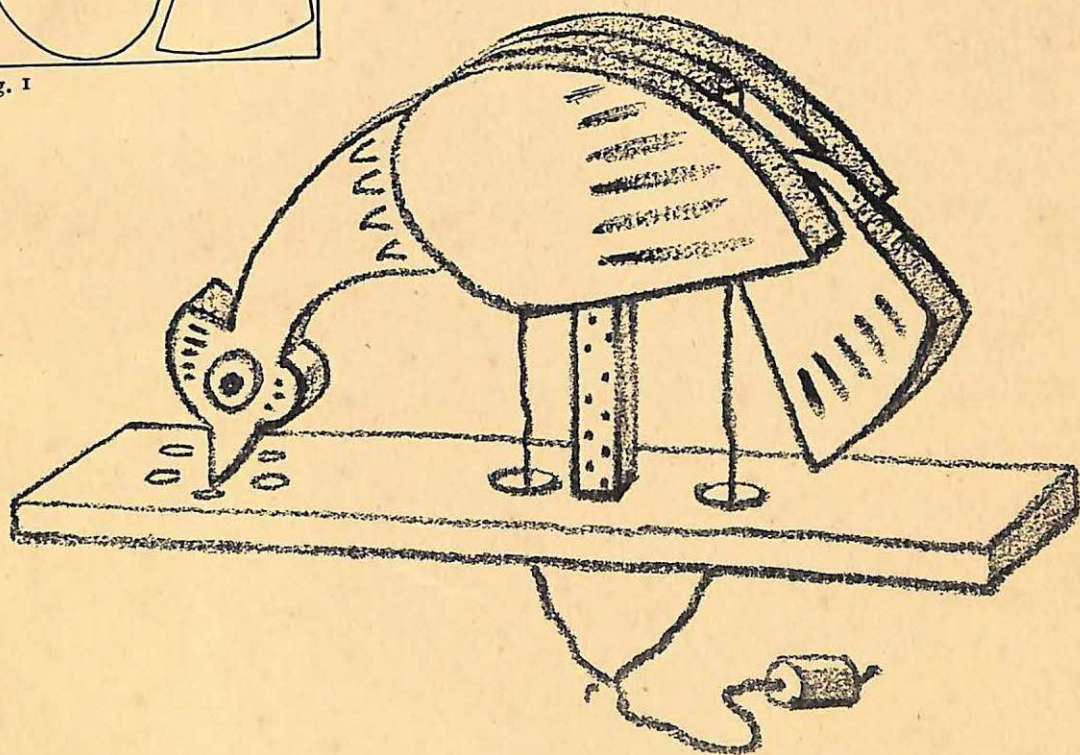


Fig. 2



## 7. JUMPING JACKS, STRINGED

### FROG

#### TOOLS:

Fretsaw, Archimedean drill, hammer, knife.

#### MATERIALS:

Wood  $5\frac{1}{4}$  in. by 2 in. by  $\frac{3}{8}$  in. for body.

Grain to run lengthwise.

Plywood about 5 in. by 4 in. for legs.

Fine string, about 12 in. long.

Tracing paper.

Glass-paper.

1 staple.

Panel pins,  $\frac{1}{2}$  in. and  $\frac{3}{4}$  in. long.

2 cotter pins, 1 in. long.

Glue.

Large bead or short length of dowel.

#### PROCEED THUS:

1. Cut out with fretsaw the various pieces as seen in the diagrams. See that the parts correspond as in Fig. 1. Shape further, if necessary.
2. Bore three holes in each of the upper leg pieces (see Fig. 2), and shave off some of the thickness as indicated by the shading. This will allow legs to move freely when placed in position between back and front pieces.
3. Bore holes in tops of lower legs to correspond to cotter pin holes in upper legs. Fasten leg pieces together with cotter pins to make knee joints. See that the joints move easily before finally flattening out the cotter pin ends.
4. String the two upper legs together (see Fig. 3). Nail them in position on back piece, but see that they swing easily on panel pins when string is pulled.
5. Glue and nail the front legs in position on back piece. These legs do not move.
6. Lay front piece in position. Test the movement of hind legs before finally gluing and nailing up.
7. Finish off string with bead or short length of dowel. Hammer staple into back at a convenient place for holding toy while string is pulled.



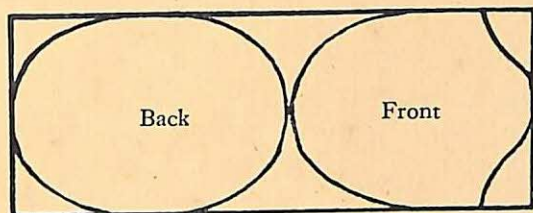


Diagram arrangement for cutting, half size.

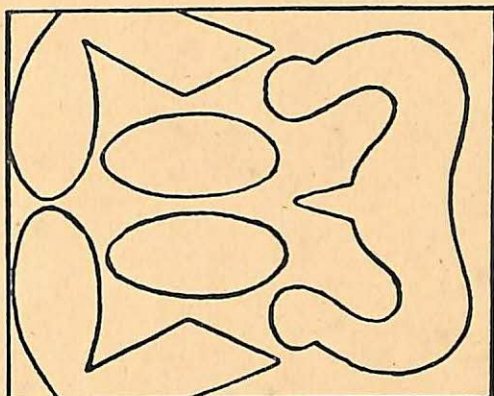


Diagram arrangement for cutting, half size.

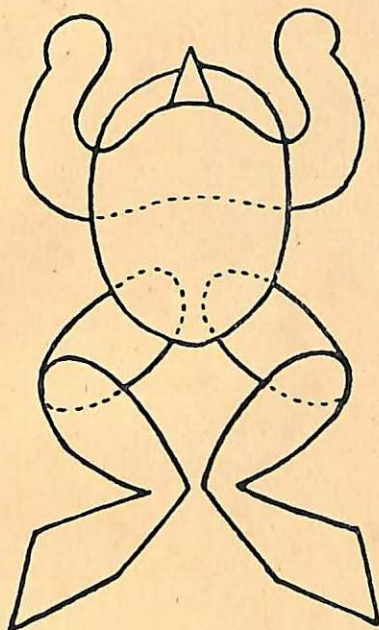


Fig. 1

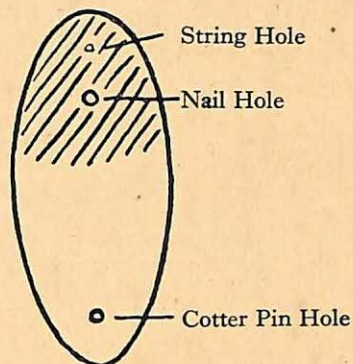


Fig. 2

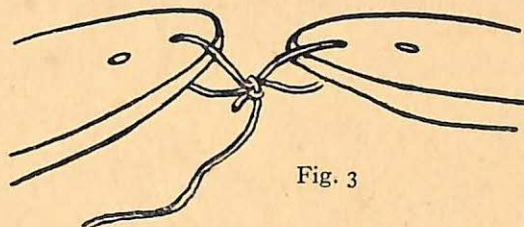
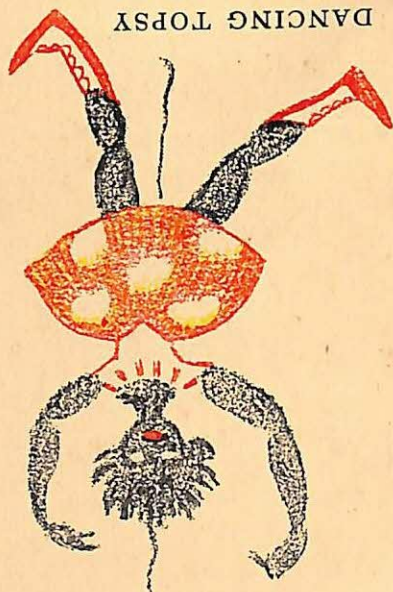


Fig. 3

Working drawings for Stringed Jumping Jack—FROG

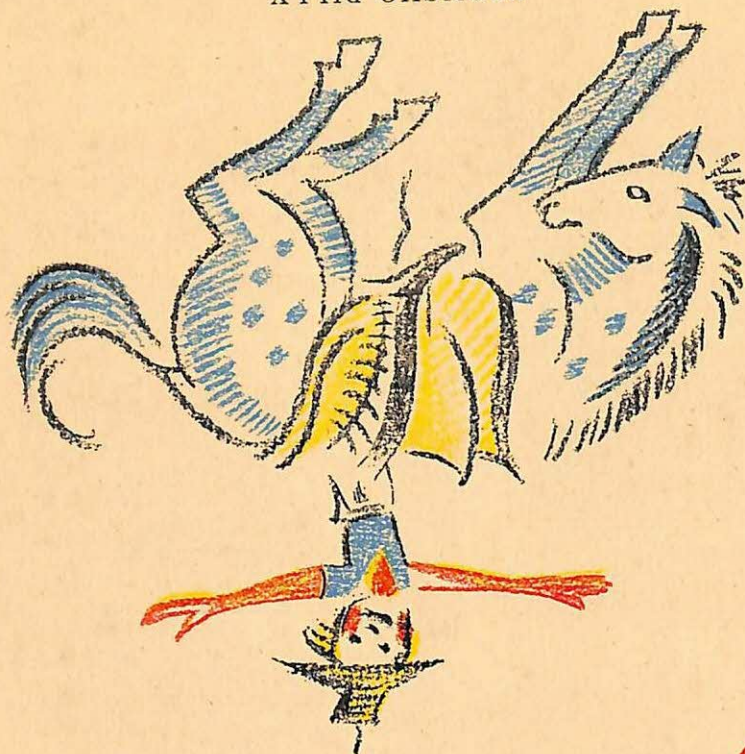
DANCING TOPSY



HORNPIPE HARRY



BRONCHO BILLY

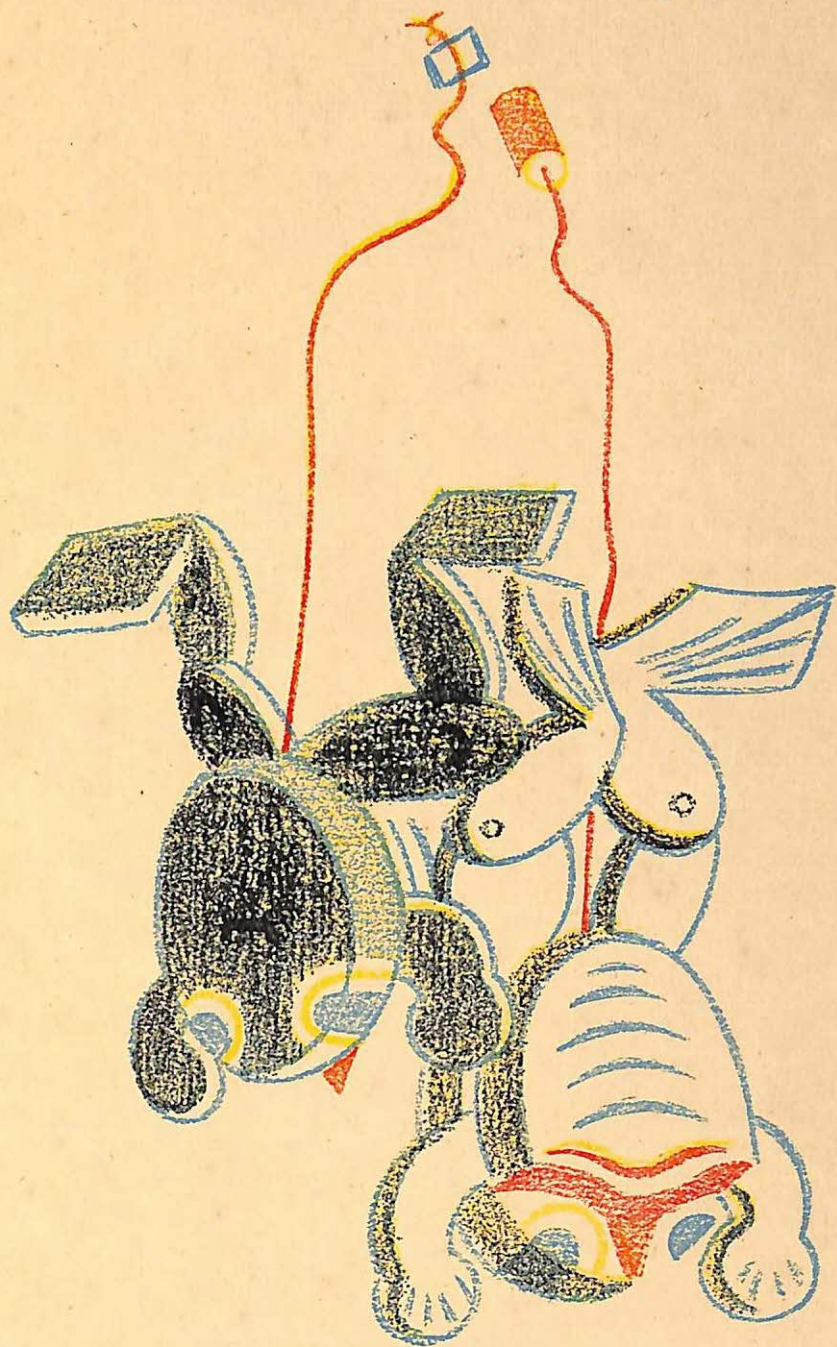


FOOTBALL PHIL





STRINGED JUMPING-JACK-FROG



For directions for making, see pages 38 and 39

## 7. JUMPING JACKS, WIRED

### TORTOISE

#### TOOLS:

Fretsaw, Archimedean drill, hammer, pliers and wire cutter.

#### MATERIALS:

Wood  $5\frac{1}{2}$  in. by 3 in. by  $\frac{3}{8}$  in. for body and pieces B and B.

Plywood about 5 in. by 5 in. for legs.

Plywood 7 in. by 2 in. for stand.

Glass-paper.

Tracing paper.

2 cotter pins, 1 in. long.

4 panel pins,  $\frac{3}{4}$  in. long.

2 staples.

7 in. tinned wire, 18 gauge.

About  $3\frac{1}{2}$  in. finer wire.

Glue.

#### PROCEED THUS:

1. Make Working Drawings (see page 16, par. 1) of the various parts, trace them on the wood, and cut out with fretsaw. See that the parts correspond as in Figs. 1 and 2. Shape further if necessary.

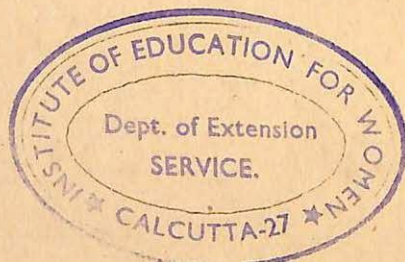
2. Bore holes in the centre of front and hind legs and corresponding holes in the stand for cotter pin joints on which the limbs will work. Test joints, but do not fix the pins yet.

3. Take the 7-in. length of wire and bend it at each end with the pliers (see Fig. 2). The length when bent should be about  $4\frac{1}{2}$  in. This wire forms the handle that works the toy.

4. Bore a small hole in front legs  $\frac{1}{2}$  in. to right of joint, and in hind legs  $\frac{1}{2}$  in. to left of joint. These holes are to take the finer wire which connects the limbs and handle. Wind the centre of this wire once round the top of the handle, leaving two ends of equal length. Thread these ends through the holes already bored for them in leg pieces.

5. Put legs in position on stand as in Fig. 1. Insert the two cotter pin joints, but do not finally flatten out their ends or the ends of the connecting wire till you have tested the movement and made any necessary adjustments. Two staples placed as in Fig. 2 will keep the handle steady when working.

6. Take the two pieces B and B (see Fig. 1), and glue them in position on the stand. Glue and nail the larger body piece on B and B, thus allowing space for the legs to work freely. Finish by gluing and nailing smaller body piece in position.





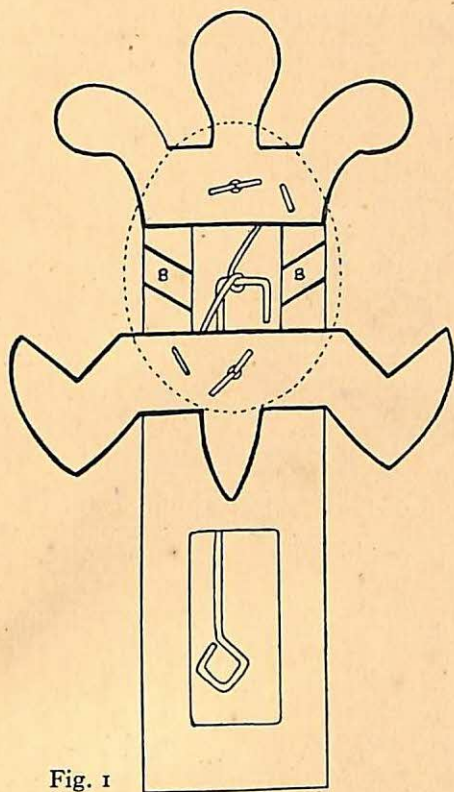


Fig. 1

Front view: showing arrangement of limbs.

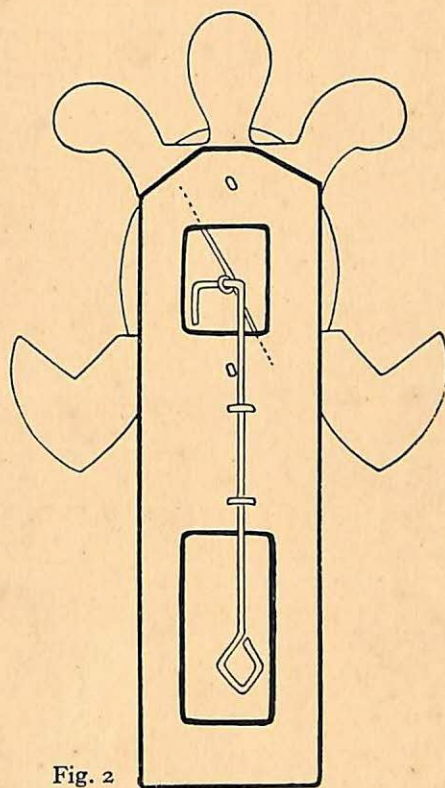
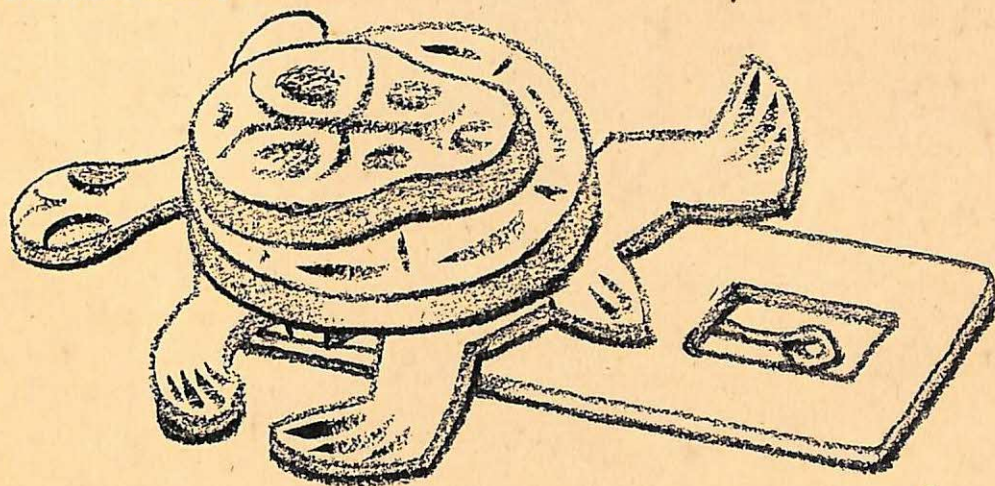


Fig. 2

Back view: showing stand.



## 7. JUMPING JACKS, WIRED

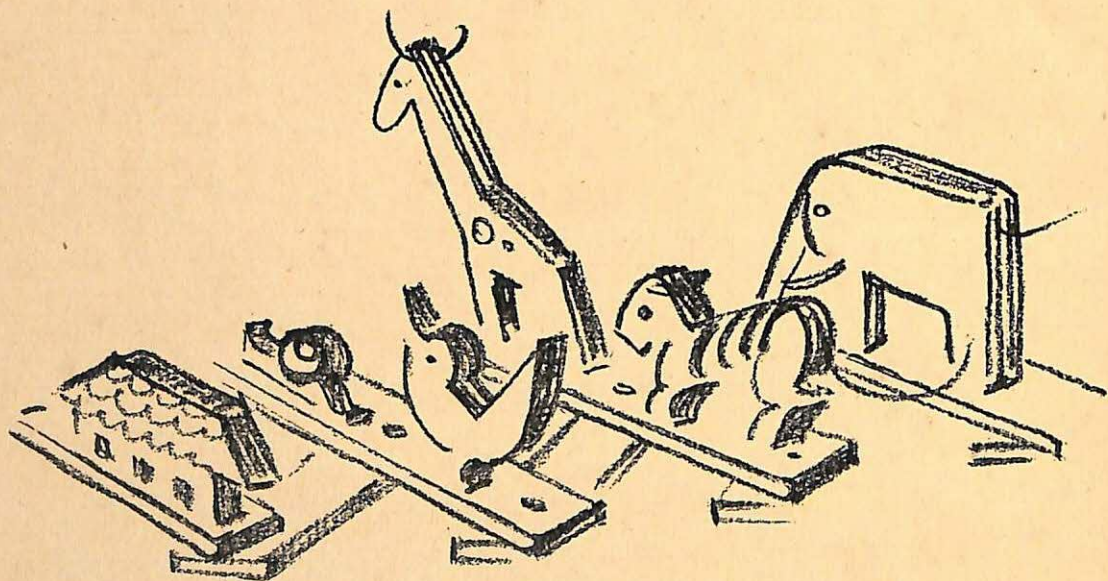
### HARLEQUIN

#### MATERIALS:

Wood  $3\frac{1}{2}$  in. by 2 in. by  $\frac{3}{4}$  in. for body.  
Plywood 6 in. by 6 in. for arms and legs.  
Plywood  $7\frac{1}{4}$  in. by 2 in. for stand.  
2 cotter pins, 1 in.  
2 panel or veneer pins,  $\frac{3}{4}$  in.

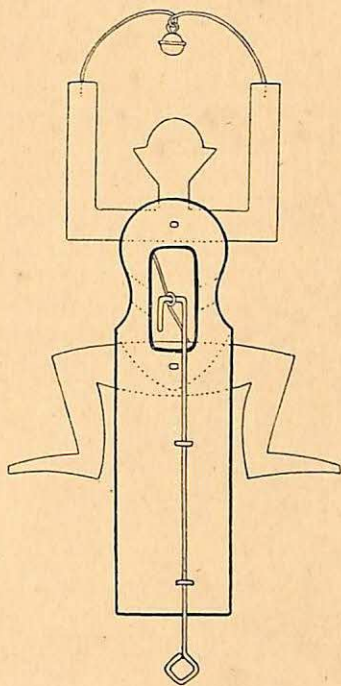
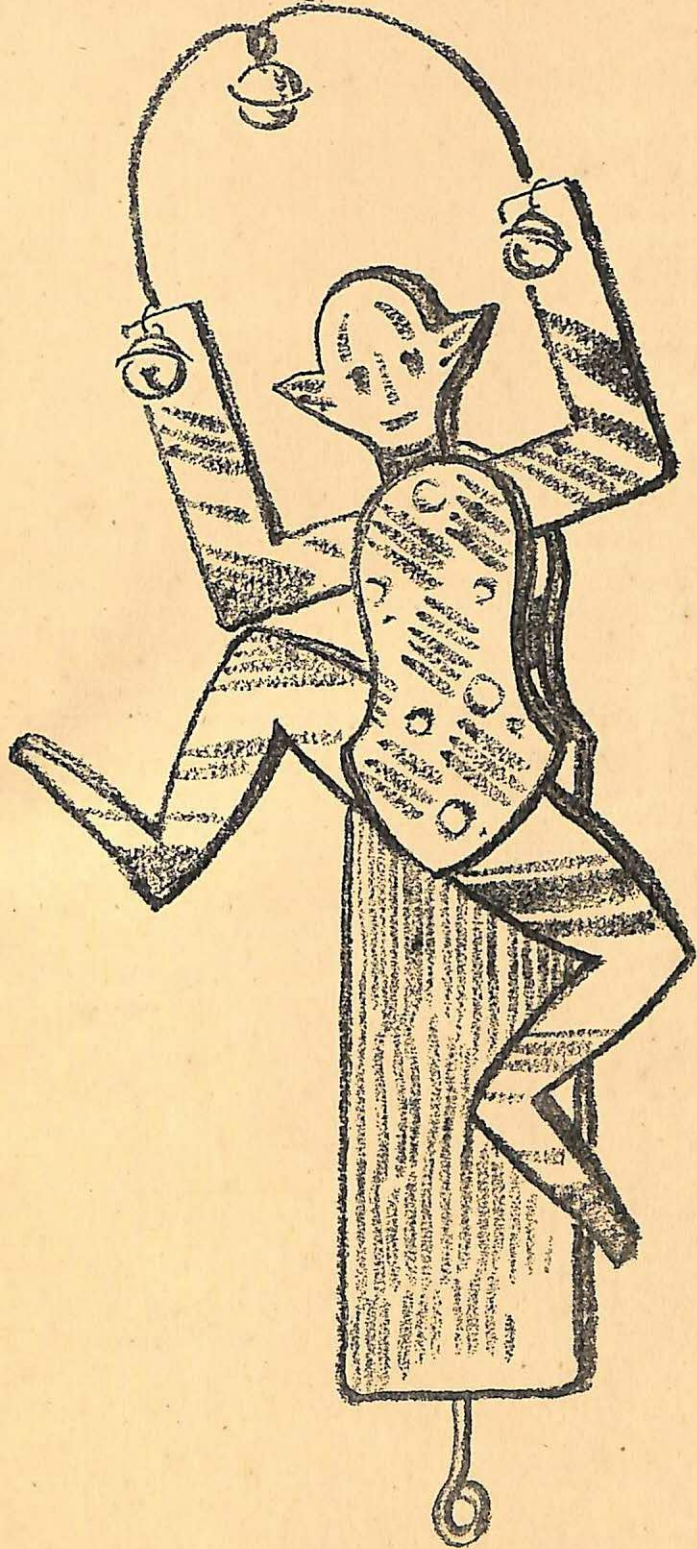
2 staples.  
10 in. tinned wire.  
About  $4\frac{1}{2}$  in. finer wire.  
About  $5\frac{1}{2}$  in. wire, to hold bell.  
3 bells.

This Jumping Jack is made in the same way as the Tortoise, the only difference being in the position in which each is held when working.



Suggestion for Noah's Ark 'scissors'—not worked out, see page 46.





Back view

## 8. HEN AND CHICKENS ON SCISSORS STAND

### TOOLS:

Fretsaw, Archimedean drill, hammer, knife or file.

### MATERIALS:

Wood about 12 in. by  $3\frac{1}{2}$  in. by  $\frac{1}{4}$  in. or  $\frac{3}{8}$  in.  
for hen and chickens.

6 strips, 4 in. by  $\frac{3}{4}$  in. }  
2 strips, 3 in. by  $\frac{3}{4}$  in. } by  $\frac{1}{4}$  in. (or ply-  
2 strips, 6 in. by 1 in. } wood) for stand.

The grain to run lengthwise.

13 wire nails, flathead,  $\frac{3}{4}$  in. long.

7 panel or veneer pins,  $\frac{1}{2}$  in. long.

Glass-paper.

Tracing paper.

Glue.

### PROCEED THUS:

1. HEN AND CHICKENS. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw.

2. STAND. Shape the two 6-in. strips as seen in Fig. 1, thus making the shaped end  $\frac{3}{4}$  in. wide to match the other strips.

3. In each strip bore holes for the connecting nails which form the joints of the 'scissors'. These holes must correspond exactly, or the joints will not work. The centre holes *must* be in the centre, and the end holes should be  $\frac{3}{8}$  in. from each end.

4. Place the strips in position and nail together, making the nails firm by clenching (see notes on page 8). Fig. 1 shows the stand when closed. Fig. 2 shows the stand when open.

5. Place the hen and chicks on stand. Fig. 1 gives their position. See that they stand steadily, making any necessary adjustments with knife or file; then fix in position with glue. They can be made specially firm by nailing up from the under side (using panel pins—the holes for the pins should be bored before gluing).



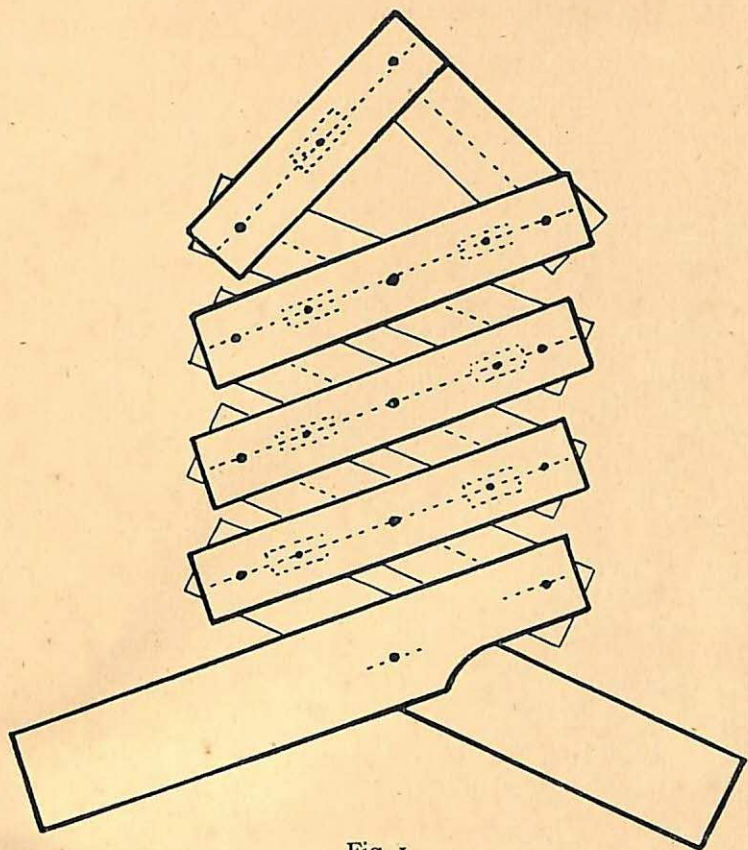


Fig. 1

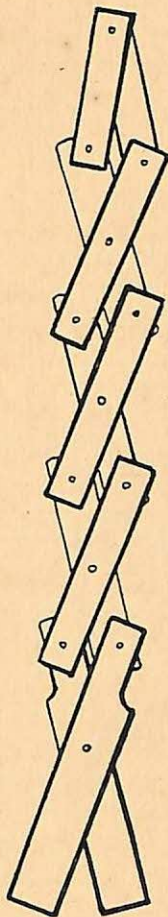
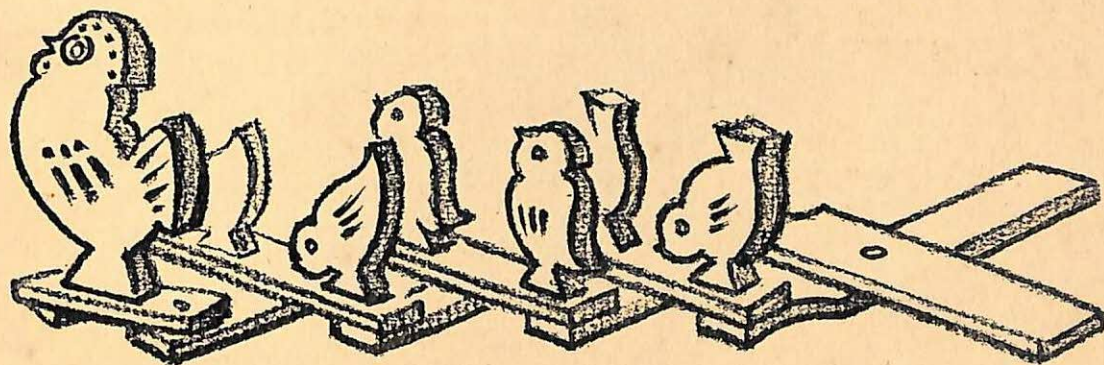


Fig. 2



# WHEELED TOYS WITH MORE COMPLICATED MOVEMENT

## I. BIRD WITH FLAPPING WINGS

### TOOLS:

Fretsaw, Archimedean drill, pair of compasses, round-nosed pliers and wire cutter, brace and bits,  $\frac{1}{8}$  in.,  $\frac{3}{16}$  in. and  $\frac{3}{8}$  in., file, screwdriver.

### MATERIALS:

|   |   |
|---|---|
| Wood $9\frac{1}{2}$ in. by $4\frac{1}{2}$ in. by $\frac{3}{8}$ in. for body and tail.     | 2 lengths tinned wire, $6\frac{1}{2}$ in., for wing supports.       |
| Wood $9\frac{1}{2}$ in. by 3 in. by $\frac{3}{8}$ in. for stand.                          | 2 lengths tinned wire, $2\frac{1}{4}$ in., for wing hinges.         |
| Wood 9 in. by 3 in. by $\frac{3}{8}$ in. for three 3-in. wheels. Grain to run lengthwise. | $\frac{3}{16}$ in. dowel, 2 in. long, for back wheel axle.          |
| Plywood $5\frac{1}{2}$ in. by $4\frac{1}{2}$ in. for wings.                               | $\frac{3}{8}$ in. dowel, 2 ft. long, for handle.                    |
| Tracing paper.  | 2 round-head screws, size 6, 1 in. long, for two front-wheel axles. |
| Glass-paper.  | 4 countersunk screws, size 2, $\frac{3}{8}$ in. long.               |

### PROCEED THUS:

1. BIRD. Make Working Drawings (see page 16, par. 1), trace them on the wood and cut out with fretsaw. As the bird is to be fitted into stand, allow an extra  $\frac{3}{8}$  in. on its feet.

2. Bore three holes in each wing, (a) one in the front edge to take small screw which will hold the wire wing support; this should be about 2 in. from the tip; (b) two holes to take wire hinges that fasten wings and body together. Bore two holes in body to correspond to these. See that they are big enough to take the wire easily.

3. Take the  $2\frac{1}{4}$  in. lengths of wire and make a small loop (with pliers) at one end of each wire. This is to prevent their slipping through holes when hinges are worked. Pass the wires through wing (from under side), through body and other wing (from upper side, so that the ends of wire can be finished off with loops on under side. See diagram). Do not finish off till the movement of wings has been tested; they should move freely from a spread position (see illustration) upwards, till all the under side is visible.

4. STAND. Place the bird in position on stand ( $\frac{1}{2}$  in. from front), and mark the outline of feet. Within this outline cut a hole, taking care to keep the hole smaller than the feet. Trim the extra  $\frac{3}{8}$  in. wood on feet to fit hole, but do not fix yet.

5. Bore a hole (using brace and  $\frac{3}{8}$  in. bit) for the dowel which forms the handle by which the toy is pushed along. This hole should be bored at an angle. (See direction of handle in illustration.)



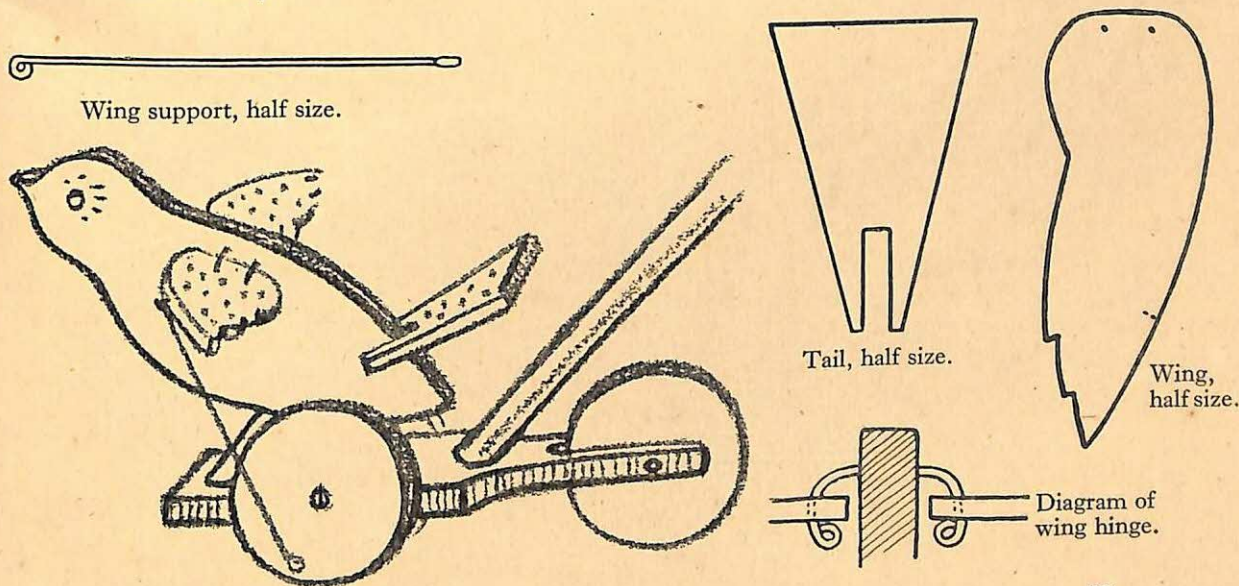
6. Shape back end of stand with fretsaw till it is about  $1\frac{3}{4}$  in. wide. Bore a hole through the side (using brace and  $\frac{3}{16}$  in. bit) to fit the dowel which forms the back wheel axle. This axle hole should be about 1 in. from end. Cut out the space in stand for the back wheel to work in.

7. WHEELS. See that the wheels correspond to each other in size and, if necessary, shape further with a file. Bore holes in the centres of the wheels for axles, using  $\frac{1}{8}$  in. bit for two front wheels and  $\frac{3}{16}$  in. bit for back wheel, and see that these holes are large enough to allow free movement on their respective axles. Place the back wheel in position, fixing the axle in the stand with glue. In each front wheel bore a small hole about  $\frac{3}{8}$  in. from the edge. These holes are to take the small screws which hold the wing supports. Fix the two front wheels in position, using the two round-headed screws as axles; the screw holes in stand for axles should be  $2\frac{1}{2}$  in. from end. Do not screw up to full extent.

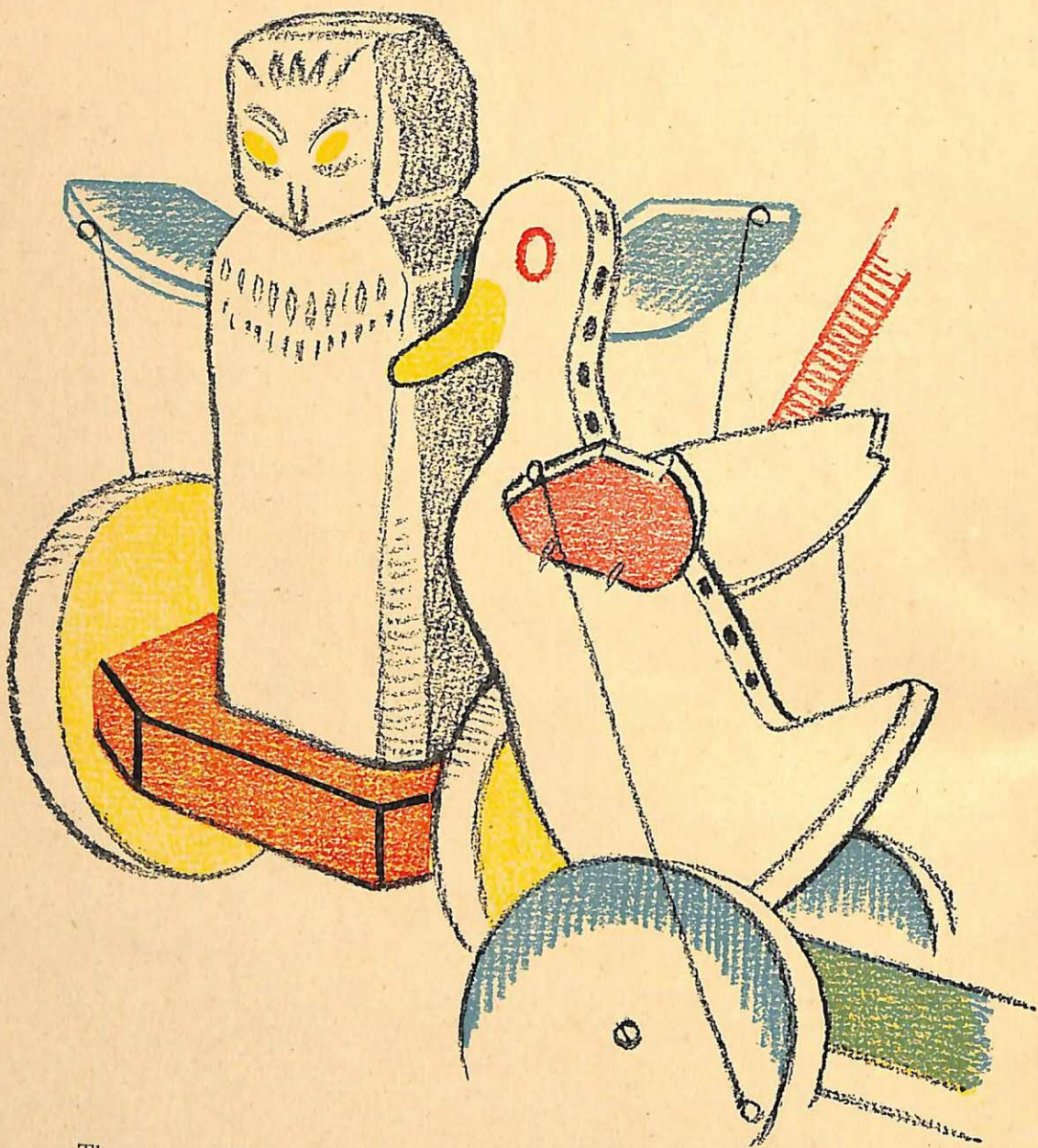
8. SUPPORTS. Make the two wing supports, noting the direction of loops at ends (see diagram). These loops are to be held in position by screw heads, but must be large enough to move freely on the screws. Screw in position on wheels with the loops lying flat; then (with the bird in place) screw the other ends of supports in position on edge of wings. Test the movement and make any necessary adjustment before finally screwing up wheels and supports.

9. Fix handle, making it firm with glue, and put tail in position.

In making other toys with similar movement to this, note that the amount of movement depends on the size of the circumference of the wheel, and therefore on the nearness of the screw (which holds the support) to that circumference. Note also that the wire supports and axle should be in line when the wing is either raised or lowered to its greatest extent. (The illustration to the 'Prancing Horse' shows this.)

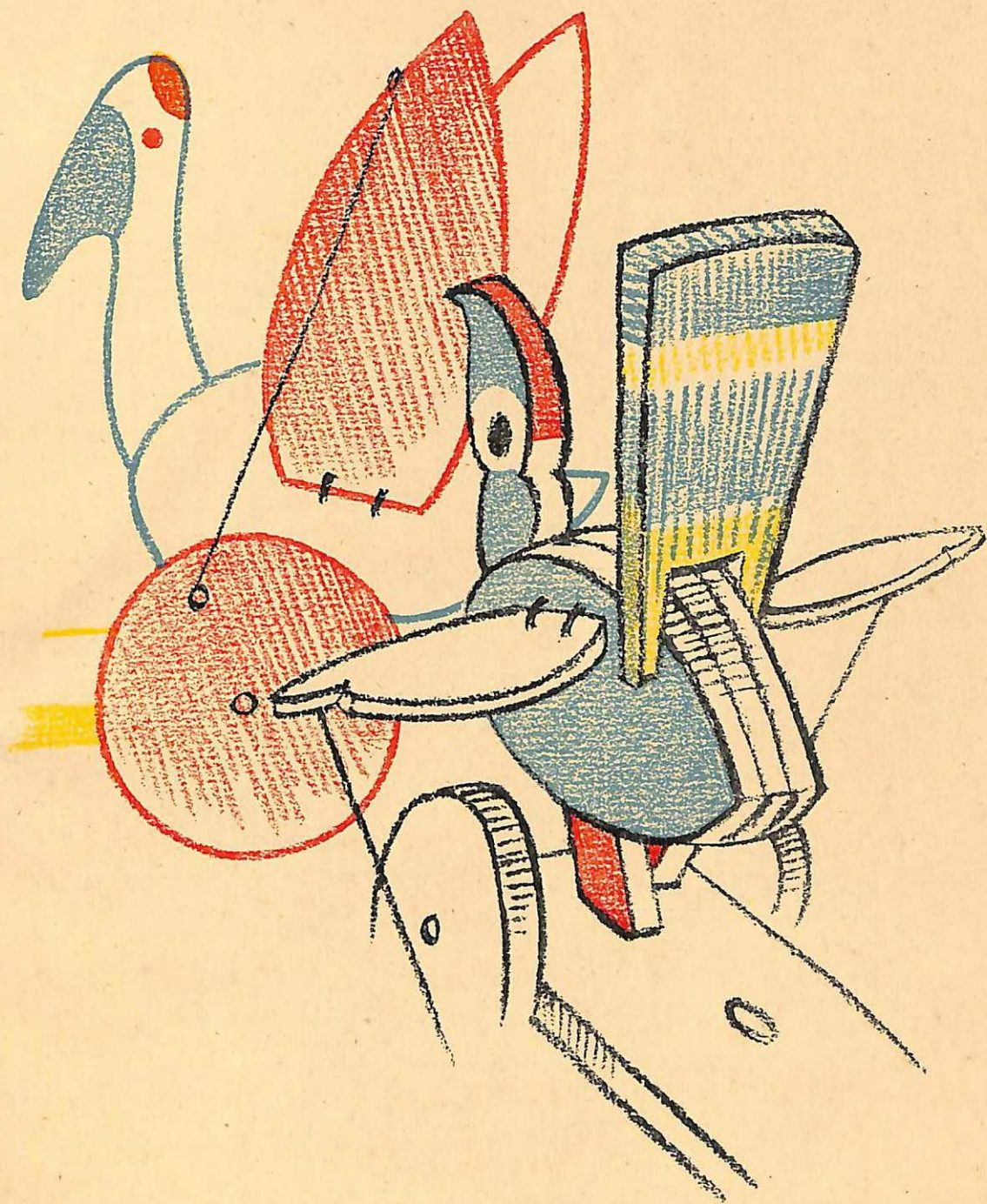






The toys on these pages were made by students on lines similar to 'Bird with Flapping Wings' (see pages 48-49).







## 2. PRANCING HORSE

### TOOLS:

Fretsaw, Archimedeian drill, screwdriver, saw, hammer, file, pair of compasses, round-nosed pliers and wire cutter, brace and bit,  $\frac{1}{8}$  in.

### MATERIALS:

|   |   |
|---|---|
| Wood 10 in. by 3 in. by $\frac{3}{8}$ in. for stand.  | About 20 panel pins, $\frac{3}{8}$ in. long.          |
| Wood 14 in. by 5 in. by $\frac{3}{8}$ in. for body, legs and bush.  | 4 round head screws, size 6, 1 in. long, for axles.   |
| Wood 11 in. by $2\frac{3}{4}$ in. by $\frac{3}{8}$ in. for four $2\frac{3}{4}$ in. wheels.                      | 2 lengths tinned wire, about 5 in., for leg supports. |
| Wood, four lengths, $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., for axle blocks.             | 5 in. length tinned wire for hinge.                   |
| Wood, strip $4\frac{1}{2}$ in. by $\frac{3}{8}$ in. by $\frac{3}{8}$ in., for leg bar. Grain to run lengthwise. | 4 countersunk screws, size 2, $\frac{3}{8}$ in. long. |
| Plywood 8 in. by $3\frac{1}{2}$ in. for middle piece of body.   | Glass-paper.  |
|   | Staple.   |
|   | Glue.   |
|   | Tracing paper.  |
|   | Piece of string.                                      |

### PROCEED THUS:

1. HORSE. This is made in three layers of wood, with the addition of four extra pieces for legs. It works on a wire hinge in hind hooves. Make Working Drawings (see page 16, par. 1), trace them on wood and cut out with fretsaw. Make up the body as on page 16.

2. The legs must be glued and nailed in position, but before fixing hind legs bore a hole in both hooves to take the wire which forms the hinge. These holes should be in line, so that the wire can be inserted without bending. When in place bend over the ends at right angles (see Fig. 1), ready for insertion in stand. Test for free movement on wire before finally fixing hind legs on body.

3. Glue and nail leg bar in position under front legs.

4. STAND. Glue and nail the axle blocks in position (see Fig. 2). Bore two holes to take the ends of the wire hinge; adjust it and test movement. The ends must be clenched on under side to keep it in place, but do not do this yet. Glue and nail 'bush' in position.

5. WHEELS. See instructions for wheels (page 49). Fix the four wheels in position on axle blocks, first boring a hole, to start the axle screw, in each block.

6. SUPPORTS. See instructions (page 49). In this instance, note direction of loops for leg bar supports (see Fig. 3). Note also position of screws in leg bar, to hold support (see illustration).

7. Fix a staple near the front of stand, and tie the length of string round it. Test movement of horse when the toy is pulled along by string and make any necessary adjustments. Finish by clenched the ends of wire hinge (see instructions for 'clenching' on page 8).



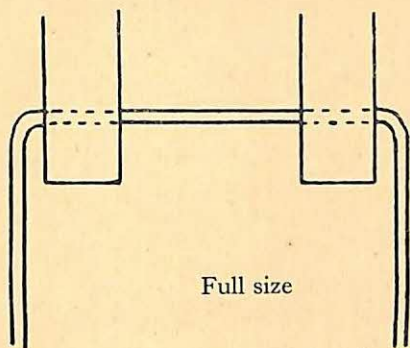


Fig. 1

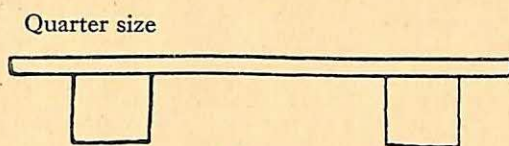


Fig. 2

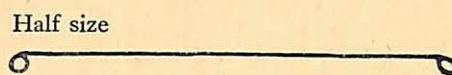
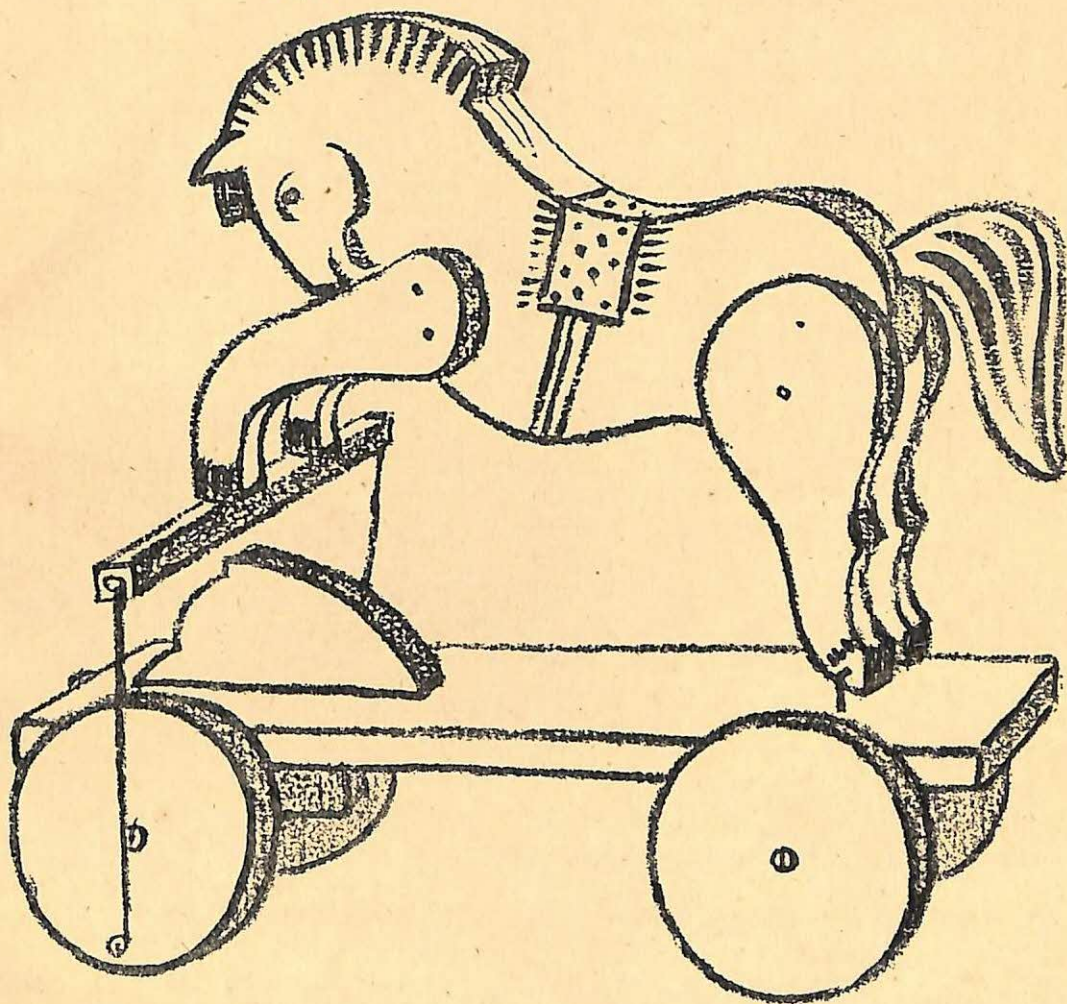


Fig. 3



### 3. 'TURNING CIRCLES'

#### TOOLS:

Saw, Archimedean drill, screwdriver, brace and bits,  $\frac{3}{16}$  in.,  $\frac{1}{4}$  in. and  $\frac{1}{2}$  in., file, hammer, pair of compasses.

#### MATERIALS:

|   |  |
|---|--|
| Wood 7 in. by 2 in. by 1 in. for base.                                  | 4 small bells.   |
| 2 strips $8\frac{1}{2}$ in. by 1 in. by $\frac{1}{4}$ in. for uprights. | Panel pins.  |
| Grain to run lengthwise.  | 4 small screw-eyes.                                    |
| 4 in. by 4 in. by $\frac{1}{4}$ in. (or plywood) to hold circles.       | 2 screws, $2\frac{1}{2}$ in. long, size 10, for axles. |
| 9 in. length dowel, $\frac{3}{4}$ in. diameter.                         | String.  |
| 2 ft. length dowel, $\frac{1}{4}$ in. diameter, for handle.             | Glue.  |
| 2 wooden wheels, $3\frac{1}{2}$ in. diameter.                           | Tracing paper.   |
| 1 wooden wheel, $2\frac{1}{2}$ in. diameter.                            | Glass-paper.   |
| 4 circles, stiff cardboard, $3\frac{1}{2}$ in. diameter.                | Cork or cube of wood for knob.                         |

#### PROCEED THUS:

1. Bore a hole in each of the two uprights  $1\frac{1}{4}$  in. from top; these holes are to take the  $\frac{3}{4}$ -in. dowel and should be large enough to allow it to turn easily. Glue and nail the uprights in position on base.

2. WHEELS. These can either be bought ready-made or can be cut out with the fretsaw as heretofore. If the wheels are bought, they should be wide enough to hold the groove for the string (see illustration and Fig. 1). This groove is made with a saw-cut to the necessary depth all round the rim, and shaped to the required width with the file. If the wheels are cut out with fretsaw, they should be made of two layers of wood, glued and nailed together; the groove should be shaped before gluing up.

3. Fix the two larger wheels in position, using the two screws as axles. The axle holes should come in the centre of the side of base. *Do not screw up to full extent yet.*

4. Now make the 'turning circles'. Take the 4 in. by 4 in. wood, and in the centre of each side make a saw-cut about  $\frac{3}{4}$  in. deep to hold circles (see illustration). Test, but do not finally fix. In exact centre of wood bore hole to take 9 in. dowel. It is *essential* that dowel and hole should fit exactly; either can be shaped with glass-paper, if necessary. Do not fix yet. At each corner of wood fasten small bell on to screw-eye.

5. Make knob out of cork or cube of wood and fit it on to dowel but do not fix yet.

6. Fit one end of 9-in. dowel into third wheel, making it fast with glue. Pass dowel through hole in upright and through hole in centre of 4 in. by 4 in. wood,



then through hole in other upright. Fix knob and the 4 in. by 4 in. wood in position with glue. Fix cardboard circles in position.

7. Adjust string on wheels as seen in illustration. It should be tight enough to connect the action of both wheels, thus 'turning the circles' as the wheels rotate.

8. Bore hole (using brace and  $\frac{1}{2}$  in. bit) for dowel which forms the handle, and by which the toy is pushed along. This hole should be bored at an angle (see direction of handle in illustration). Note that it must avoid touching the circles when they are turning.

9. Fix handle in base with glue. Finally, adjust the axles of wheels at base, screwing them up till they run steadily but freely.

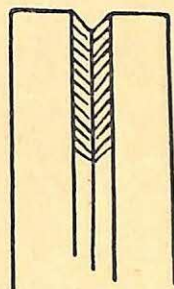
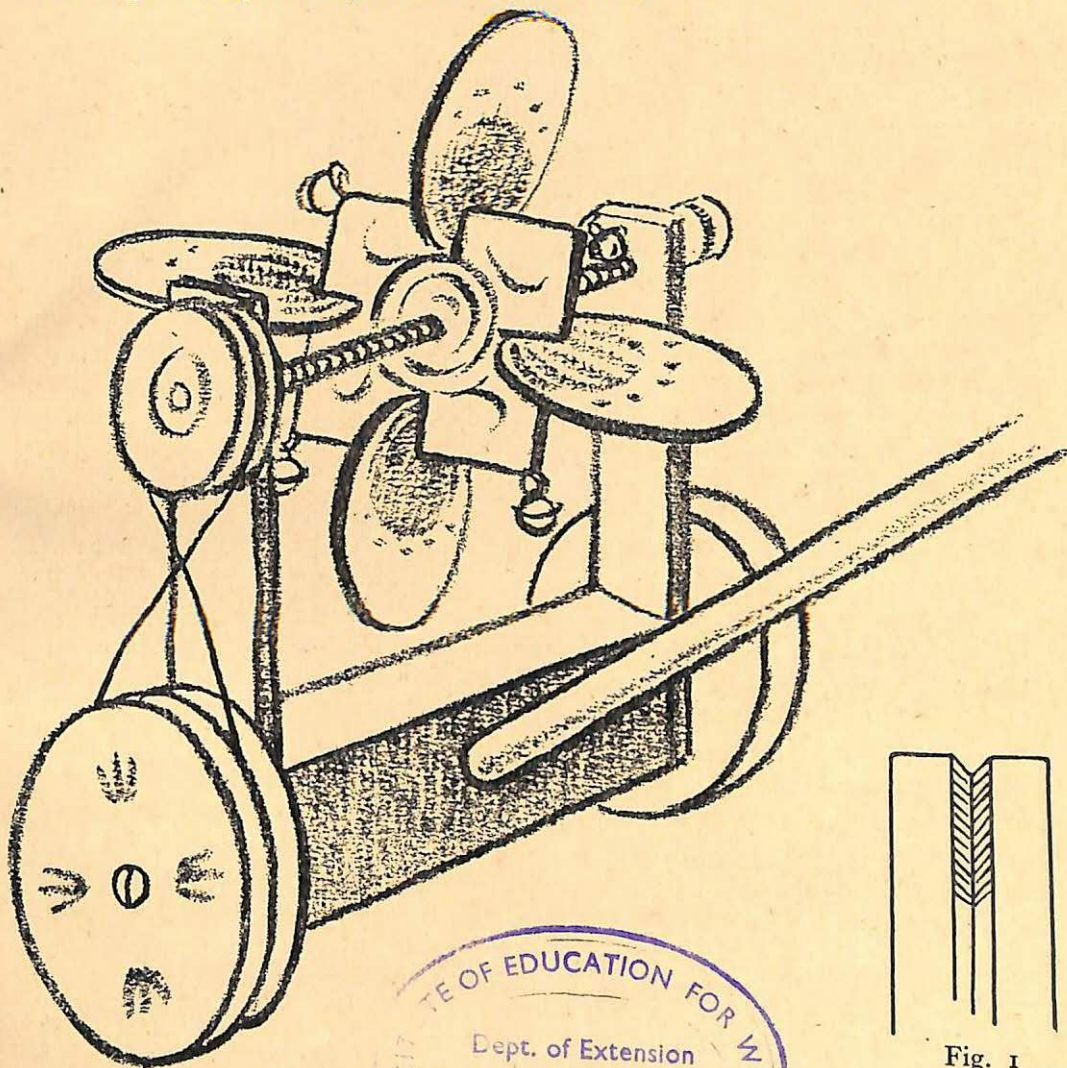


Fig. 1

